SOIL SURVEY OF

Knox, Monroe, and Shelby Counties, Missouri

United States Department of Agriculture
Soil Conservation Service
In cooperation with
Missouri Agricultural Experiment Station

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all who need the information, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1968–72. Soil names and descriptions were approved in 1973. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1968. This survey was made cooperatively by the Soil Conservation Service and the Missouri Agricultural Experiment Station. It is part of the technical assistance furnished to the Knox County, Monroe County, and Shelby County Soil and Water Conservation Districts.

Soil maps in this survey may be copied without permission, but any enlargement of these maps could cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY of Knox, Monroe, and Shelby Counties contains information that can be applied in managing farms and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Knox, Monroe, and Shelby Counties are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information in the survey. This guide lists all of the soils in the survey area in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the capability units.

Interpretations not included in this survey can be developed by using the soil map and information in the text to group the soils according to their suitability or limitations for a particular use. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those that have a moderate limitation can be colored yellow, and those that have a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the descriptions of the capability units.

Foresters and others can refer to the section "Woodland," where certain soils are rated according to their suitability for growing trees.

Game managers, sportsmen, and others concerned with wildlife can find information about soils and wildlife in the section "Wildlife."

Engineers and builders can find in the section "Engineering Uses of the Soils" information on soil properties and features that affect engineering practices.

Recreation specialists can find information on suitability and limitations of each soil for specified recreational facilities in the section "Recreation."

Scientists and others can refer to the section on "Formation and Classification of the Soils" to find how the soils formed and how they are classified.

Students, teachers, and others will find information about soils and their management in various parts of the text.

Newcomers to Knox, Monroe, and Shelby Counties may be especially interested in the section "General Soil Map" where broad patterns of soils are described. They may also be interested in the section "Additional Facts about the Counties."

Cover: **Typical land use on Mexico silt loam, 2 to 5 percent slopes, in the survey area.**

Contents

Issued August 1979

Index to Mapping Units

Summary of Tables

SOIL SURVEY OF KNOX, MONROE, AND SHELBY COUNTIES, MISSOURI

BY F. CONRAD WATSON, SOIL CONSERVATION SERVICE

FIELDWORK BY JERRY A. DODD, PAUL E. MINOR, WILLIAM R. PAULS, GEORGE D. ROBERTSON, F. CONRAD WATSON, AND JAMES E. YARBROUGH, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE MISSOURI AGRICULTURAL EXPERIMENT STATION

KNOX, MONROE, AND SHELBY COUNTIES are located in the northeastern part of Missouri (fig. 1). They cover a total area of about 1,682 square miles, or 1,076,608 acres. According to the 1970 census, the survey area has a population of about 23,140. The county seats in the survey area are Edina in Knox County, Paris in Monroe County, and Shelbyville in Shelby County.

Most of the acreage in the survey area is in farms. Farming and agriculturally oriented businesses are the main enterprises. Generally, farms produce grain and livestock. The major crops are corn, soybeans, and wheat. Much of the grain is fed to cattle and hogs.

The survey area ranges from broad, nearly level, upland flats to steep wooded slopes. Nearly level flood plains are along the major streams. The soils formed in loess and glacial till and in material weathered from shale and limestone. The soils on bottom lands are variable, and wetness is a limitation on most of these soils.

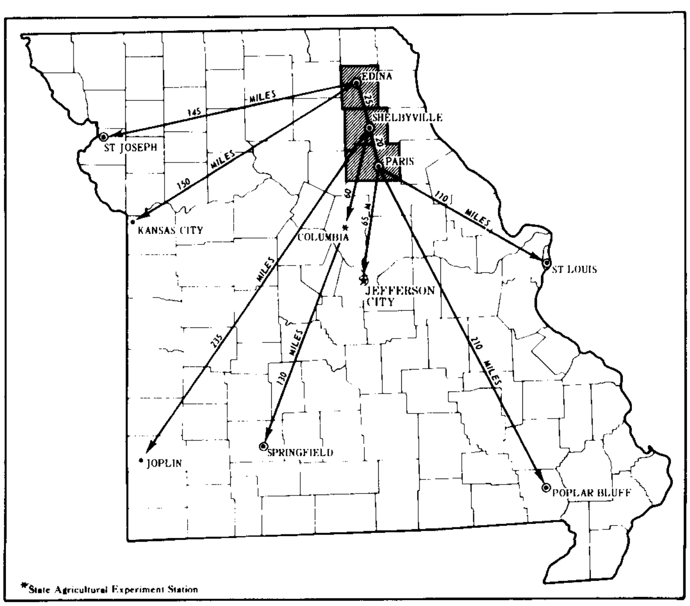

***Figure 1.*—Location of Knox, Monroe, and Shelby Counties in Missouri.**

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Knox, Monroe, and Shelby Counties, where they are located, and how they can be used. The soil scientists went into the survey area knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and nature of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. For example, Goss and Arbela are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Lindley loam, 14 to 20 percent slopes, is one of the phases within the Lindley series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. The photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some kind that have been seen within an area that is dominantly of a recognized soil phase.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Rock land is a land type in this survey area.

While a soil survey is in progress, scientists take soil samples. The samples collected in this survey were used in soil correlation. Data on a soil's yield of crops under defined practices are assembled from farm records and from field or plot experiments on the same kind of soil. Yields under a defined level of management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants, and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that septic tank filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or to a high water table. They see that streets, road pavements, and foundations for houses are cracked on a given kind of soil, and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The three general soil maps at the back of this survey show, in color, the soil associations in Knox, Monroe, and Shelby Counties. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association can occur in another as well, but in a different proportional pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The four soil associations in Knox, Monroe, and Shelby Counties are discussed in the following pages.

1. Mexico-Putnam association

Deep, somewhat poorly drained and poorly drained, very slowly permeable, nearly level to gently sloping soils; on uplands

This association occurs throughout the survey area and makes up about 37 percent of the counties. It is about 38 percent Mexico soils, 32 percent Putnam soils, and 30 percent less extensive soils.

Mexico soils are somewhat poorly drained and have a surface layer of very dark grayish-brown silt loam. The upper part is grayish-brown silty clay loam; the middle part is dark-gray and gray silty clay that has bright mottles; and the lower part is gray silty clay loam and silt loam. Mexico soils are on the tops and gently sloping sides of convex ridges. They are downslope from and adjacent to Putnam soils. Mexico and Putnam soils formed in silty, windblown material.

Putnam soils are poorly drained and have a surface layer of very dark grayish-brown silt loam. The subsurface layer is grayish-brown silt loam. The upper part of the subsoil is dark-gray, dark grayish-brown, and grayish-brown silty clay; the lower part is grayish-brown silty clay loam. Putnam soils are on nearly level, broad flats.

Less extensive in this association are Leonard, Armstrong, and Kilwinning soils. Leonard and Kilwinning soils are somewhat poorly drained. Armstrong soils are moderately well drained. Leonard and Armstrong soils are downslope from Mexico soils. In the northern one-fourth of the survey area, Kilwinning soils occur downslope from and in association with Putnam soils.

Soils in this association are used mainly for corn, soybeans, small grain, and meadow grasses (fig. 2). Some farming is for cash grain crops, and the rest is general. Wetness and the hazard of erosion are the major limitations to the use and management of the soils. Land grading helps to remove excess water from Putnam soils. Terracing, farming on the contour, using minimum tillage, and returning crop residue to the soil help to control erosion on Mexico soils.

2. Armstrong-Leonard association

Deep, moderately well drained and somewhat poorly drained, slowly permeable, moderately sloping to strongly sloping soils; on uplands

Figure 2.—**Corn, in foreground, on Mexico silt loam, 2 to 5 percent slopes, and wheat, in background, on Putnam silt loam.**

This association occurs throughout the survey area and makes up about 23 percent of the counties. It is about 47 percent Armstrong soils, 46 percent Leonard soils, and 7 percent less extensive soils.

Armstrong soils are moderately well drained and have a surface layer of very dark grayish-brown loam. The upper part of the subsoil is dark-brown and strong-brown silty clay; the lower part is yellowish-brown clay loam. Armstrong soils are on moderately sloping and strongly sloping side slopes. They formed in glacial till. They are downslope from Leonard soils.

Leonard soils are somewhat poorly drained and have a surface layer of very dark grayish-brown silt loam. The subsoil is dark grayish-brown silty clay loam and gray and grayish-brown silty clay. Leonard soils are along the heads of drainageways and on moderately sloping and strongly sloping side slopes.

Less extensive in this association are Mexico, Gara, and Keswick soils. Mexico soils formed in loess. They are gently sloping soils upslope from the other less extensive associated soils. Gara and Keswick soils formed in glacial till and are downslope from associated soils.

The moderately sloping soils in this association are used for corn and soybeans, and the strongly sloping soils are used for hay. The hazard of erosion is the major limitation to the use and management of the soils. Constructing terraces and waterways, farming on the contour, using minimum tillage, and returning crop residue to the soil help to control erosion.

3. *Lindley-Keswick association*

Deep, well drained and moderately well drained, moderately slowly permeable and slowly permeable, moderately sloping to steep soils; on uplands

This association (fig. 3) occurs throughout the survey area and makes up about 23 percent of the counties. It is about 31 percent Lindley soils, 30 percent Keswick soils, and 39 percent less extensive soils.

Lindley soils are well drained and have a surface layer of dark-gray loam. The subsoil is yellowish-brown and strong-brown clay loam. Lindley soils are on moderately steep and steep side slopes along drainageways. They are downslope from Keswick soils.

Keswick soils are moderately well drained and have a surface layer of dark-brown loam. The subsoil is strong-brown, yellowish-red, or red clay loam or clay. Keswick soils are on sloping to strongly sloping ridgetops and sides of ridges.

Less extensive in this association are Gorin, Gara, Goss, Calwoods, Gosport, and Marion soils and Rock land. Marion soils formed in loess and are in nearly level wooded areas. Gorin and Calwoods soils formed in loess over glacial till and are downslope from adjacent Marion soils. Gara soils formed in glacial till and are upslope from Lindley soils. Gosport soils formed in material weathered from shale and other residuum and are downslope from Keswick and Calwoods soils. Small areas of Goss soils and Rock land are intermingled with areas of Gosport and Lindley soils.

The cleared acreage in this association is used for crops and pasture. Most areas of Lindley soils are wooded. The hazard of erosion is the major limitation to the use and management of the soils. Maintaining adequate permanent grass and tree cover helps to control erosion.

4. *Piopolis-Blackoar-Arbela association*

Deep, poorly drained and somewhat poorly drained,

Figure 3.—**Pasture on Lindley-Keswick association. Keswick soil is in foreground, and Lindley soil is on steeper breaks.**

moderately permeable and slowly permeable, nearly level soils; on bottom lands and adjacent terraces

This association (fig. 4) occurs throughout the survey area and makes up about 17 percent of the counties. It is about 27 percent Piopolis soils, 19 percent Blackoar soils, 12 percent Arbela soils, and 42 percent less extensive soils.

Piopolis soils are poorly drained and have a surface layer of dark-gray silty clay loam. The underlying material is gray and grayish-brown silty clay loam. Piopolis soils are on slightly higher elevations than associated soils and are not adjacent to streams.

Blackoar soils are poorly drained and have a surface layer of very dark grayish-brown and very dark gray silt loam. They occur in large and small areas along the smaller streams.

Arbela soils are somewhat poorly drained and have a surface layer of very dark grayish-brown and very dark gray silt loam. The subsurface layer is gray and dark gray. The subsoil is dark-gray and dark grayish-brown silty clay loam. Arbela soils are on slightly higher elevations than associated soils and are not adjacent to streams.

Less extensive in this association are Fatima, Chequest, Moniteau, Kickapoo, and Wabash soils, which are along streams and in depressions on nearly level flood plains, and Gifford, Chariton, and Auxvasse soils, which are on high terraces of streams or on second bottoms. Vigar soils are on the base of uplands.

The soils in this association are used mainly for corn, soybeans, and small grains. Wetness is the major limitation to the use and management of the soils. In places periodic flooding is a limitation. Constructing drainage ditches and land grading help to remove excess water.

Descriptions of the Soils

This section describes the soil series and mapping units in Knox, Shelby, and Monroe Counties. Each soil series is described in detail, and then each mapping unit in that series is described briefly. Unless specifically stated otherwise, it is assumed that what is stated about a soil series holds true for each mapping unit in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the

Figure 4.—**Corn and soybeans on Piopolis-Blackoar-Arbela association. Piopolis and Blackoar soils are in the lower, wetter areas, and Arbela soils are on the slightly elevated positions.**

layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. The profile described for the series is representative of mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in the description of the mapping unit, or they are apparent in the name of the mapping unit. Color terms used in describing the profiles are for moist soil unless otherwise stated.

As mentioned in the section "How This Survey Was Made," not all mapping units belong to a soil series. Rock land, for example, is a land type rather than part of a soil series, but nevertheless, it is listed in alphabetic order along with the soil series.

Preceding the name of each mapping unit is a symbol that identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit in which the mapping unit is placed. The page for the description of each capability unit can be learned by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*9*).[1]

[1] Italic numbers in parentheses refer to Literature Cited, page 52.

Arbela Series

The Arbela series consists of deep, somewhat poorly drained, nearly level soils on low terraces of bottom lands. These soils formed in silty and clayey alluvial sediment. The native vegetation was tall prairie grasses.

In a representative profile the surface layer is very dark grayish-brown and very dark gray silt loam about 13 inches thick. The subsurface layer is dark-gray and gray silt loam about 10 inches thick. The subsoil is dark-gray and dark grayish-brown, firm silty clay loam about 52 inches thick.

Arbela soils have moderately slow permeability. Available water capacity is high. Organic-matter content is moderate, and natural fertility is high.

These soils are easily tilled. Crops respond well to lime and fertilizer.

Representative profile of Arbela silt loam, in a cultivated field, 650 feet east and 33 feet south of the northwest corner of NE¼ sec. 35, T. 63 N., R. 10 W., in Knox County:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, fine, granular structure; very friable; neutral; gradual, smooth boundary.

A12—7 to 13 inches, very dark gray (10YR 3/1) silt loam; moderate, fine, granular structure; very friable; neutral; abrupt, smooth boundary.

A21—13 to 17 inches, dark-gray (10YR 4/1) silt loam; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, thin, platy structure; very friable; slightly acid; clear, smooth boundary.

A22—17 to 23 inches, gray (10YR 5/1) silt loam; few, fine, distinct, yellowish-brown (10YR 5/6) and dark-

TABLE 1.—*Approximate acreage and proportion extent of the soils*

Soil	Knox County		Monroe County		Shelby County		Total acres
	Acres	Percent	Acres	Percent	Acres	Percent	
Arbela silt loam	9,000	2.7	3,650	0.9	8,400	2.6	21,050
Armstrong loam, 5 to 9 percent slopes	37,000	11.3	32,250	7.6	11,500	3.6	80,750
Armstrong loam, 9 to 14 percent slopes, eroded	26,000	7.9	24,250	5.8	8,500	2.7	58,750
Auxvasse silt loam	162	([1])	2,450	.6	890	.3	3,502
Blackoar silt loam	23,000	7.0	3,950	.9	7,300	2.3	34,250
Borrow pits	—	—	6	([1])	—	—	6
Calwoods silt loam, 2 to 5 percent slopes	—	—	6,100	1.4	3,200	1.0	9,300
Chariton silt loam	5,000	1.5	2,800	.7	2,550	.8	10,350
Chequest silty clay loam	6,400	2.0	195	([1])	2,600	.8	9,195
Clay pits	—	—	6	([1])	—	—	6
Fatima silt loam	7,000	2.1	2,400	.6	1,250	.4	10,650
Gara loam, 9 to 14 percent slopes	1,650	.5	373	([1])	1,000	.3	3,023
Gara loam, 14 to 20 percent slopes	19,800	6.0	520	.1	2,250	.7	22,570
Gifford silt loam, 2 to 5 percent slopes	1,700	.5	2,950	.7	2,100	.7	6,750
Gifford silt loam, 5 to 9 percent slopes	2,400	.7	1,700	.4	1,500	.5	5,600
Gorin silt loam, 5 to 9 percent slopes, eroded	10,800	3.3	13,000	3.0	9,800	3.1	33,600
Gosport silty clay loam, 5 to 9 percent slopes	—	—	1,450	.3	—	—	1,450
Gosport silty clay loam, 9 to 14 percent slopes	—	—	2,000	.5	—	—	2,000
Gosport silty clay loam, 14 to 20 percent slopes	—	—	2,300	.5	—	—	2,300
Goss cherty silt loam, 20 to 30 percent slopes	930	.3	13,400	3.2	1,100	.3	15,430
Keswick loam, 5 to 9 percent slopes, eroded	4,050	1.3	18,600	4.3	11,600	3.6	34,250
Keswick loam, 9 to 14 percent slopes, eroded	3,800	1.3	29,500	6.9	16,200	5.1	49,500
Kickapoo fine sandy loam	1,350	.4	2,750	.6	2,000	.6	6,100
Kilwinning silt loam, 2 to 5 percent slopes	59,500	18.3	—	—	1,350	.4	60,850
Leonard silt loam, 5 to 9 percent slopes, eroded	32,500	9.9	62,279	14.6	47,000	14.6	141,779
Leonard silt loam, 9 to 14 percent slopes, eroded	207	([1])	—	—	550	.2	757
Lindley loam, 14 to 20 percent slopes	5,000	1.5	18,200	4.3	16,200	5.1	39,400
Lindley loam, 20 to 30 percent slopes	20,500	6.3	10,500	2.6	6,100	1.9	37,100
Marion silt loam, 0 to 2 percent slopes	207	([1])	253	([1])	235	([1])	695
Marion silt loam, 2 to 5 percent slopes	870	.3	4,750	1.1	1,350	.4	6,970
Mexico silt loam, 2 to 5 percent slopes	5,900	1.8	76,279	17.9	62,500	19.4	144,679
Mexico silt loam, 2 to 5 percent slopes, eroded	1,100	.3	5,000	1.2	14,000	4.4	20,100
Moniteau silt loam	610	.2	4,450	1.0	4,550	1.4	9,610
Piopolis silty clay loam	3,200	1.0	31,000	7.2	17,200	5.4	51,400
Putnam silt loam	32,500	10.0	45,000	10.5	51,500	16.1	129,000
Rock land	—	—	2,750	.6	415	.1	3,165
Rock quarry	83	([1])	98	([1])	20	([1])	201
Strip mine	—	—	202	([1])	—	—	202
Vigar loam, 2 to 5 percent slopes	2,550	.8	146	([1])	1,200	.4	3,896
Wabash silty clay	2,600	.8	290	([1])	2,550	.8	5,440
Water	311	([1])	363	([1])	308	([1])	982
Total	327,680	100.00	428,160	100.00	320,768	100.00	1,076,608

[1] Less than 0.05 percent.

brown (10YR 3/3) mottles; weak, thin, platy structure; very friable; strongly acid; abrupt, smooth boundary.

B2tg—23 to 43 inches, dark-gray (10YR 4/1) and dark grayish-brown (10YR 4/2) heavy silty clay loam; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, fine, subangular blocky structure; firm; thick continuous, very dark grayish-brown (10YR 3/2) clay films; strongly acid; gradual, smooth boundary.

B3tg—43 to 75 inches, dark grayish-brown (10YR 4/2) silty clay loam; common, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, fine, subangular blocky structure; firm; thin continuous clay films; few concretions of oxides; medium acid.

The Ap horizon is very dark gray or very dark grayish brown and ranges from 7 to 11 inches in thickness. The A2 horizon ranges from 8 to 12 inches in thickness. The B horizon is dark gray, dark grayish brown, or gray.

Arbela soils formed in the same kind of material as Blackoar and Piopolis soils. They have a finer textured B horizon than Blackoar soils. They have a thicker A horizon and are better drained than Piopolis soils.

Ar—Arbela silt loam. This level to nearly level soil is on low terraces of streams. It is in uniformly shaped areas about 20 to 60 acres in size.

Included with this soil in mapping are small areas of Piopolis and Blackoar soils. These areas make up about 10 percent of the mapped acreage.

Runoff is slow. Wetness is a moderate limitation.

This soil is used mainly for row crops commonly grown in the survey area. Capability unit IIw–1.

Armstrong Series

The Armstrong series consists of deep, moderately well drained, moderately sloping and strongly sloping soils. These soils formed in glacial till. The native vegetation was mixed prairie grasses and deciduous trees.

In a representative profile the surface layer is very dark grayish-brown loam about 7 inches thick. The subsoil extends to a depth of 70 inches. It is dark-brown, firm silty clay in the upper part; strong-brown, very firm silty clay in the middle part; and yellowish-brown, firm clay loam in the lower part.

Armstrong soils have slow permeability. Available water capacity is moderate. Organic-matter content is moderately low, and natural fertility is medium.

These soils are used for row crops and hay.

Representative profile of Armstrong loam, 5 to 9 percent slopes, in a cultivated field, 600 feet west and 66 feet north of the southeast corner of sec. 12, T. 57 N., R. 9 W., in Shelby County:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) loam; moderate, fine, granular structure; friable; many fine roots; slightly acid; clear, smooth boundary.

B1t—7 to 15 inches, dark-brown (7.5YR 4/4) light silty clay; few, fine, distinct, grayish-brown (10YR 5/2) and reddish-brown (5YR 4/4) mottles; weak, fine, subangular blocky structure; firm; few fine roots; thin discontinuous clay films; very strongly acid; clear, smooth boundary.

B21t—15 to 27 inches, strong-brown (7.5YR 5/6) silty clay; common, fine, distinct, gray (10YR 5/1) and few, fine, distinct, yellowish-red (5YR 4/6) mottles; moderate, medium, subangular blocky structure; very firm; thin discontinuous clay films; black (10YR 2/1) organic stains; strongly acid; clear, smooth boundary.

B22t—27 to 40 inches, strong-brown (7.5YR 5/6) silty clay; many, medium, distinct, light brownish-gray (2.5Y 6/2) and few, fine, distinct, reddish-brown (5YR 4/4) mottles; moderate, medium, subangular blocky structure; very firm; thin discontinuous clay films; strongly acid; gradual, smooth boundary.

B3t—40 to 70 inches, yellowish-brown (10YR 5/6) clay loam; few, medium, distinct, grayish-brown (2.5Y 5/2) mottles; weak, medium, subangular blocky structure; firm; thin discontinuous clay films; black (10YR 2/1) organic stains on faces of peds; neutral.

The Ap horizon is very dark gray or very dark grayish brown and is 7 to 9 inches thick. The B2 horizon is strong-brown to yellowish-red silty clay or clay. The B3 horizon is yellowish-brown or strong-brown clay loam or silty clay loam.

Armstrong soils are near Keswick and Leonard soils on the landscape. They have a thicker Ap or A1 horizon than Keswick soils. They have higher chroma colors in the matrix of the B2 horizon than Leonard soils.

AtC—Armstrong loam, 5 to 9 percent slopes. This soil is on the sides and convex tops of ridges. It is in irregularly shaped areas about 10 to 40 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Leonard, Mexico, and Gara soils. These areas make up about 10 percent of the mapped acreage. Also included are small areas of strongly sloping Armstrong soils and some areas of severely eroded Armstrong soils. The severely eroded areas make up less than 1 percent of the mapped acreage. They are shown on the soil map by an erosion symbol that represents 2 acres.

Runoff is medium. This soil erodes easily if cultivated. Constructing terraces helps to control erosion.

This soil is suited to crops commonly grown in the survey area, such as corn, soybeans, wheat, and alfalfa or red clover. Capability unit IIIe–5.

AtD2—Armstrong loam, 9 to 14 percent slopes, eroded. This soil is on side slopes. It is in irregularly shaped areas about 10 to 25 acres in size.

Included with this soil in mapping are areas of Gara and Lindley soils. These areas make up less than 10 percent of the mapped acreage. Also included are areas of severely eroded Armstrong soil. These areas are shown on the soil map by an erosion symbol that represents 2 acres.

Runoff is rapid. The hazard of erosion is severe. Farming on the contour helps to control erosion.

This soil is used mainly for hay and pasture. Capability unit IVe–5.

Auxvasse Series

The Auxvasse series consists of deep, poorly drained, nearly level soils on high terraces along streams. These soils formed in silty and clayey material. The native vegetation was mixed hardwood trees.

In a representative profile the surface layer is dark grayish-brown silt loam about 6 inches thick. The subsurface layer is light brownish-gray silt loam about 12 inches thick. The subsoil is firm and extends to a depth of 75 inches. It is dark grayish-brown silty clay in the upper part; grayish-brown silty clay loam in the middle part; and mottled, gray and dark-brown silty clay loam in the lower part.

Auxvasse soils have very slow permeability. Available water capacity is high. Organic-matter content and natural fertility are low.

Most areas of these soils are used for row crops commonly grown in the survey area.

Representative profile of Auxvasse silt loam, in a small wooded area, 200 feet east and 500 feet south of the middle of sec. 1, T. 62 N., R. 10 W., in Knox County:

A1—0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, fine, granular structure; friable; many fine roots; very strongly acid; abrupt, smooth boundary.

A2—6 to 18 inches, light brownish-gray (10YR 6/2) silt loam; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, platy structure breaking to moderate, fine, granular; friable; few fine and medium roots; very strongly acid; abrupt, smooth boundary.

B&A—18 to 21 inches, grayish-brown (10YR 5/2) light silty clay loam; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, fine, angular blocky structure; firm; white (10YR 8/1) coating of silt when dry; very strongly acid; clear, smooth boundary.

B2t—21 to 34 inches, dark grayish-brown (10YR 4/2) silty clay; many, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, fine, subangular blocky structure; very firm; few fine and medium roots; thin continuous clay films; very strongly acid; gradual, smooth boundary.

B31t—34 to 49 inches, grayish-brown (10YR 5/2) heavy silty clay loam; few, fine, distinct, dark-brown (10YR 4/3) and few, fine, distinct, strong-brown (7.5YR 5/6) mottles; moderate, fine, subangular blocky structure; firm; thin continuous clay films; very strongly acid; gradual, smooth boundary.

B32t—49 to 75 inches, mottled, gray (10YR 6/1) and dark-brown (7.5YR 4/4) medium silty clay loam; weak, medium, subangular blocky structure; firm; thick continuous clay flows; slightly acid.

The A1 horizon is dark grayish brown or grayish brown and ranges from 6 to 9 inches in thickness. The A2 horizon is light brownish gray or grayish brown and ranges from 8 to 12 inches in thickness. It has yellowish-brown or dark-brown mottles. The B2 horizon is dark grayish brown and grayish brown and has yellowish-brown and dark-brown mottles. The B3 horizon is grayish-brown, dark grayish-brown, or gray silty clay loam, or clay loam.

Auxvasse soils formed in the same type of material as Chariton and Gifford soils. They have a lighter colored A1 horizon than Chariton soils. They have an A2 horizon that is lacking in Gifford soils.

Au—Auxvasse silt loam. This level and nearly level soil is on high terraces of streams. It occurs only along the major streams in irregularly shaped areas about 5 to 10 acres in size.

Runoff is slow. Wetness is a severe limitation. Land grading or land smoothing help to remove excess water.

This soil is suited to crops commonly grown in the survey area. Because areas of this soil are small and are not easily accessible to machinery, some areas are in permanent pasture. Capability unit IIIw-2.

Blackoar Series

The Blackoar series consists of deep, poorly drained, nearly level soils on bottom lands. These soils formed in silty and loamy alluvial sediment. The native vegetation was tall prairie grasses.

In a representative profile the surface layer is very dark grayish-brown and very dark gray silt loam about 19 inches thick. The subsoil is gray, friable silt loam about 39 inches thick. The underlying material is gray fine sandy loam and loam.

Blackoar soils have moderate permeability. Available water capacity is very high. Organic-matter content is moderate, and natural fertility is high.

Most areas of these soils are well suited to cultivated crops. Flooding is a limitation.

Representative profile of Blackoar silt loam in a cultivated field, 72 feet east and 580 feet south of the northwest corner of SW¼ sec. 9, T. 62 N., R. 10 W., in Knox County:

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, fine, granular structure; friable; few fine roots; neutral; gradual, smooth boundary.

A12—10 to 19 inches, very dark gray (10YR 3/1) silt loam; moderate, very fine, granular structure; friable; few fine roots; neutral; clear, smooth boundary.

B21g—19 to 42 inches, gray (10YR 6/1) silt loam; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, fine, subangular blocky structure; friable; few fine roots; neutral; gradual, smooth boundary.

B22g—42 to 58 inches, gray (10YR 5/1) heavy silt loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, fine, subangular blocky structure; friable; few fine roots; neutral; clear, smooth boundary.

C1g—58 to 65 inches, gray (10YR 5/1 and 6/1) fine sandy loam; common, medium, distinct, dark-brown (10YR 4/3) mottles; massive; friable; neutral; clear, smooth boundary.

C2g—65 to 70 inches, gray (10YR 5/1) loam; common, medium, distinct, dark-brown (10YR 3/3) mottles; massive; friable; neutral.

The Ap and A12 horizons are very dark gray or very dark grayish brown and range from 12 to 20 inches in thickness. The B2 horizon is dark gray or gray. The C horizon is dark-gray or gray silt loam, loam, or fine sandy loam.

Blackoar soils are near Arbela and Piopolis soils on the landscape. They lack an A2 horizon, which is characteristic of Arbela soils. They have a thicker and darker colored A horizon than Piopolis soils.

Bk—Blackoar silt loam. This level and nearly level soil is along meanders of old stream channels and in narrow stream valleys. It is in irregularly shaped areas about 10 to 50 acres in size.

Included with this soil in mapping are small areas of Chequest and Piopolis soils. These areas make up about 10 percent of the mapped acreage.

Runoff is slow. Wetness is a moderate limitation. This soil is subject to periodic flooding. Surface drainage ditches and land grading or smoothing help to remove excess water.

This soil is well suited to crops commonly grown in the survey area. It is also well suited to walnut trees. Capability unit IIw-1.

Calwoods Series

The Calwoods series consists of deep, somewhat poorly drained, gently sloping soils on tops of ridges. These soils formed in thin loess overlying reworked glacial till. The native vegetation was deciduous trees.

In a representative profile the surface layer is dark grayish-brown silt loam about 5 inches thick. The subsurface layer is brown silt loam about 5 inches thick. The subsoil extends to a depth of 70 inches. It is brown, firm silty clay loam in the upper part; gray, very firm silty clay in the middle part; and light brownish-gray, gray, yellowish-brown, strong-brown, and red, firm silty clay loam and silty clay in the lower part.

Calwoods soils have slow permeability. Available water capacity is high. Organic-matter content is low, and natural fertility is medium.

These soils are used for row crops commonly grown in the survey area.

Representative profile of Calwoods silt loam, 2 to 5 percent slopes, in a cultivated field, 1,320 feet south and 230 feet west of the northeast corner of sec. 26, T. 54 N., R. 10 W., in Monroe County:

A1—0 to 5 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, fine, granular structure; friable; few fine roots; medium acid; abrupt, smooth boundary.

A2—5 to 10 inches, brown (10YR 5/3) silt loam; few, fine, faint, yellowish-brown (10YR 5/6) and light brownish-gray (10YR 6/2) mottles; weak, thin, platy structure; friable; few fine roots; very strongly acid; clear, smooth boundary.

B1t—10 to 15 inches, brown (10YR 5/3) silty clay loam; common, fine, distinct, red (2.5YR 4/6) and yellowish-red (5YR 4/6) and common, fine, faint, grayish-brown (10YR 5/2) mottles; weak, fine, subangular blocky structure; firm; few fine roots; thin discontinuous clay films; very strongly acid; clear, smooth boundary.

B21t—15 to 21 inches, gray (10YR 5/1) silty clay; common, fine, distinct, yellowish-red (5YR 4/6) mottles; weak and moderate, fine, subangular blocky structure; very firm; thin continuous clay films; very strongly acid; clear, smooth boundary.

B22t—21 to 26 inches, gray (10YR 5/1) silty clay; common, fine, distinct, strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; very firm; thin continuous clay films; very strongly acid; clear, smooth boundary.

B3t—26 to 52 inches, light brownish-gray (10YR 6/2) silty clay loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, fine, subangular blocky structure; firm; thin discontinuous clay films; black (10YR 2/1) oxide stains; very strongly acid; clear, smooth boundary.

IIB2t—52 to 70 inches, mottled, gray (10YR 6/1), yellowish-brown (10YR 5/6), strong-brown (7.5YR 5/6), and red (2.5YR 4/6) silty clay; moderate, fine, subangular blocky structure; firm; thin discontinuous clay films; few coarse grains of sand and glacial pebbles; slightly acid.

The A1 horizon is dark grayish brown or grayish brown and is 3 to 5 inches thick. The A2 horizon is brown or grayish brown and is 3 to 5 inches thick. In cultivated areas, material from the A2 horizon generally is mixed with that originally in the A1 horizon. The B2 horizon is gray or grayish brown. The B3 horizon is light brownish gray or grayish brown.

Calwoods soils formed in the same kind of material as Mexico and Marion soils. They have a thinner, lighter colored A horizon than Mexico soils. They lack the abrupt texture break that is characteristic of Marion soils.

CaB—Calwoods silt loam, 2 to 5 percent slopes. This soil is on the sides and tops of convex ridges. It is in uniformly shaped areas 5 to 25 acres in size.

Included with this soil in mapping are areas of Mexico and Marion soils. These areas make up about 10 percent of the mapped acreage.

Runoff is slow. The hazard of erosion is moderate. Constructing terraces helps to control erosion.

This soil is used mainly for corn and soybeans. Some of the smaller areas remain in trees. Capability unit IIe–5.

Chariton Series

The Chariton series consists of deep, poorly drained, nearly level soils on terraces higher than the flood plains. These soils formed in loess overlying sandy alluvium. The native vegetation was tall prairie grasses.

In a representative profile the surface layer is very dark grayish-brown silt loam about 8 inches thick. The subsurface layer is gray silt loam about 8 inches thick. The subsoil is about 40 inches thick. It is very dark grayish-brown, very firm silty clay in the upper part; dark grayish-brown and grayish-brown, very firm silty clay in the middle part; and grayish-brown, firm silty clay loam in the lower part. The underlying material is gray fine sandy loam.

Chariton soils have slow permeability. Available water capacity is high. Organic-matter content is moderate, and natural fertility is high.

These soils are used for row crops commonly grown in the survey area.

Representative profile of Chariton silt loam, in a cultivated field, 73 feet north and 30 feet east of the center of sec. 10, T. 63 N., R. 10 W., in Knox County:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, fine, granular structure; very friable; slightly acid; abrupt, smooth boundary.

A2—8 to 16 inches, gray (10YR 5/1) silt loam; few, fine, distinct, dark-brown (10YR 4/3) mottles; moderate, thin, platy structure; very friable; very strongly acid; abrupt, smooth boundary.

B21t—16 to 22 inches, very dark grayish-brown (10YR 3/2) silty clay; dark grayish-brown (10YR 4/2), crushed; few, fine, faint, dark-brown (10YR 4/3) mottles; weak and moderate, fine, subangular blocky structure; very firm; thin continuous clay films; very strongly acid; clear, smooth boundary.

B22t—22 to 34 inches, dark grayish-brown (10YR 4/2) silty clay; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, fine, subangular blocky structure; very firm; thin continuous clay films; strongly acid; clear, smooth boundary.

B23t—34 to 42 inches, grayish-brown (2.5Y 5/2) silty clay; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, fine, subangular blocky structure; very firm; thin discontinuous clay films; black (10YR 2/1) oxide stains; medium acid; clear, smooth boundary.

B3t—42 to 56 inches, grayish-brown (2.5Y 5/2) silty clay loam; common, medium, distinct, strong-brown (7.5YR 5/8) mottles; weak, fine, subangular blocky structure; firm; thin discontinuous clay films; some fine sand; slightly acid; clear, smooth boundary.

C—56 to 80 inches, gray (10YR 5/1) fine sandy loam; many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; structureless; friable; black (10YR 2/1) streaks of oxides; sand content increases with depth; slightly acid.

The Ap horizon is very dark gray or very dark grayish brown and is 7 to 9 inches thick. The A2 horizon is gray, dark grayish brown, or grayish brown and is 6 to 8 inches thick. The B horizon is very dark grayish brown to grayish brown. The C horizon is silt loam or fine sandy loam.

Chariton soils formed in the same kind of material as Auxvasse and Gifford soils. They have a darker colored Ap horizon than Auxvasse soils. They have an A2 horizon, which is lacking in Gifford soils.

Ch—Chariton silt loam. This level and nearly level soil is on high stream terraces in uniformly shaped areas about 10 to 60 acres in size. It occurs along major streams.

Runoff is slow. Wetness is a moderate limitation. Constructing surface drainage ditches helps to remove excess water. In some places erosion is a hazard on long slopes.

This soil is well suited to corn and soybeans. Some areas are used for hay. Capability unit IIw–2.

Chequest Series

The Chequest series consists of deep, poorly drained, nearly level soils on bottom lands. These soils formed in clayey alluvial sediment. The native vegetation was tall prairie grasses.

In a representative profile the surface layer is very dark gray silty clay loam about 12 inches thick. The subsoil is about 68 inches thick. It is dark-gray, firm silty clay loam in the upper part and gray, firm silty clay loam in the lower part.

Chequest soils have moderately slow permeability. Available water capacity is high. Organic-matter content is moderate, and natural fertility is high.

These soils are used for row crops commonly grown in the survey area. Wetness is a moderate to severe limitation.

Representative profile of Chequest silty clay loam, in a cultivated field, 500 feet south and 550 feet east of the center of sec. 9, T. 58 N., R. 12 W., in Shelby County:

Ap—0 to 7 inches, very dark gray (10YR 3/1) silty clay loam; moderate, fine, granular structure; firm; many fine roots; medium acid; gradual, smooth boundary.

A12—7 to 12 inches, very dark gray (10YR 3/1) silty clay loam; few, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, fine, subangular blocky structure; firm; common fine roots; strongly acid; clear, smooth boundary.

B21g—12 to 22 inches, dark-gray (10YR 4/1) silty clay loam; common, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, fine, subangular blocky structure; firm; few fine roots; thin discontinuous clay films; strongly acid; gradual, smooth boundary.

B22g—22 to 46 inches, dark-gray (10YR 4/1) silty clay loam; common, fine, distinct, dark-brown (7.5YR 4/4) mottles; moderate, fine, subangular blocky structure; firm; thin discontinuous clay films; common, discontinuous, light-gray (10YR 6/1) coatings of silt; strongly acid; clear, smooth boundary.

B31g—46 to 62 inches, gray (10YR 5/1) silty clay loam; many, fine, distinct, strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; firm; few thin clay films in root channels; few, discontinuous, light-gray (10YR 7/1) coatings of silt; neutral; gradual, smooth boundary.

B32g—62 to 80 inches, gray (10YR 5/1) light silty clay loam; common, fine, distinct, strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; firm; sand content increases with depth; neutral.

The Ap horizon is very dark grayish brown or very dark gray and ranges from 7 to 10 inches in thickness. The B horizon is dark gray or gray.

Chequest soils are near Blackoar and Wabash soils on the landscape. They have more clay throughout the profile than Blackoar soils. They have less clay throughout the profile than Wabash soils.

Cm—Chequest silty clay loam. This level and nearly level soil is on flood plains. It is in uniformly shaped areas about 10 to 50 acres in size.

Included with this soil in mapping are small areas of Wabash and Blackoar soils. These areas make up about 10 percent of the mapped acreage.

Runoff is slow. Wetness is a moderate limitation. This soil is subject to occasional flooding. Constructing surface drainage ditches and land grading or smoothing help to remove excess water.

This soil is well suited to corn and soybeans. Capability unit IIw–2.

Fatima Series

The Fatima series consists of deep, moderately well drained, nearly level soils on bottom lands. These soils formed in silty alluvial sediment. The native vegetation was deciduous trees.

In a representative profile the surface layer is very dark grayish-brown silt loam about 14 inches thick. The subsoil is about 54 inches thick. It is brown, friable silt loam in the upper part; yellowish-brown, friable silt loam in the middle part; and grayish-brown, friable silt loam in the lower part.

Fatima soils have moderate permeability. Available water capacity is very high. Organic-matter content is moderate, and natural fertility is high.

These soils are easily tilled. Flooding is the main limitation.

Representative profile of Fatima silt loam, in a small wooded area, 650 feet east of the center of sec. 10, T. 62 N., R. 10 W., in Knox County:

A1—0 to 14 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, very fine, granular structure; friable; few fine roots; slightly acid; clear, smooth boundary.

B1—14 to 24 inches, brown (10YR 5/3) silt loam; few, fine, faint, grayish-brown (10YR 5/2) mottles; weak, fine, subangular blocky structure; friable; slightly acid; gradual, smooth boundary.

B2—24 to 36 inches, yellowish-brown (10YR 5/4) silt loam; few, fine, faint, grayish-brown (10YR 5/2) mottles; weak, fine, subangular blocky structure; friable; medium acid; clear, smooth boundary.

B3—36 to 68 inches, grayish-brown (10YR 5/2) silt loam; many, fine, distinct, dark-brown (10YR 4/3) and dark yellowish-brown (10YR 4/4) mottles; weak, fine, subangular blocky structure; friable; appreciable content of fine sand; very strongly acid.

The A1 horizon is very dark grayish brown or very dark gray and ranges from 11 to 15 inches in thickness. The B horizon is brown and yellowish brown to grayish brown.

Fatima soils formed in the same kind of material as Piopolis and Blackoar soils. They have less clay throughout the profile than Piopolis soils. They are better drained than Blackoar soils.

Fa—Fatima silt loam. This level and nearly level soil is on flood plains near streams. It is in irregularly shaped areas about 10 to 50 acres in size.

Included with this soil in mapping are small areas of Blackoar and Piopolis soils. These areas make up about 10 percent of the mapped acreage. Also included are areas of Fatima soils that have a sandy overwash. These areas are shown on the soil map by a sand spot symbol.

Runoff is slow. This soil is subject to occasional flooding.

In many places this soil is covered by trees. Cleared areas are well suited to corn and soybeans. Walnut trees grow well on this soil. Capability unit I–1.

Gara Series

The Gara series consists of deep, moderately well drained, strongly sloping and moderately steep soils on sides of slopes. These soils formed in glacial till. The native vegetation was mixed prairie grasses and deciduous trees.

In a representative profile the surface layer is very dark grayish-brown loam about 9 inches thick. The subsoil is dark yellowish-brown, yellowish-brown, and strong-brown, firm clay loam about 61 inches thick.

Gara soils have moderately slow permeability. Available water capacity is high. Organic-matter content is moderate, and natural fertility is medium. Erosion is a very severe hazard.

These soils are better suited to hay or pasture than to most other uses.

Representative profile of Gara loam, 9 to 14 percent slopes, in a pasture, 200 feet west and 800 feet north of the southeast corner of NE¼ sec. 25, T. 63 N., R. 12 W., in Knox County:

A1—0 to 9 inches, very dark grayish-brown (10YR 3/2) loam; moderate, fine, granular structure; friable; common fine roots; neutral; abrupt, smooth boundary.

B21t—9 to 19 inches, dark yellowish-brown (10YR 4/4) clay loam; weak, fine, subangular blocky structure; firm; common fine roots; thin continuous clay films; distinct, grayish-brown (10YR 5/2), grainy coatings; strongly acid; gradual, smooth boundary.

B22t—19 to 27 inches, yellowish-brown (10YR 5/4) clay loam; moderate, fine, subangular blocky structure; firm; thin continuous clay films; distinct, grayish-brown (10YR 5/2), grainy coatings; very strongly acid; clear, smooth boundary.

B23t—27 to 34 inches, dark yellowish-brown (10YR 4/4) light clay loam; common, medium, distinct, light brownish-gray (2.5Y 6/2) mottles; moderate, fine, subangular blocky structure; firm; thin continuous clay films; very strongly acid; clear, smooth boundary.

B31t—34 to 45 inches, strong-brown (7.5YR 5/6) light clay loam; common, medium, distinct, light brownish-gray (2.5Y 6/2) mottles; weak, medium, subangular blocky structure; thin discontinuous clay films; strongly acid; clear, smooth boundary.

B32t—45 to 70 inches, yellowish-brown (10YR 5/6) light clay loam; common, medium, distinct, light brownish-gray (2.5Y 6/2) mottles; weak, medium, subangular blocky structure; firm; thin discontinuous clay films; black (10YR 2/1) and dark grayish-brown (10YR 4/2) clay flows in root channels; mildly alkaline.

The A1 horizon is very dark grayish brown or very dark gray and is 7 to 9 inches thick. The B horizon is dark yellowish brown, yellowish brown, strong brown, or dark brown.

Gara soils formed in the same kind of material as Armstrong and Lindley soils. They lack red mottles, which are characteristic of Armstrong soils. They have a thicker A1 or Ap horizon than Lindley soils.

GaD—Gara loam, 9 to 14 percent slopes. This soil is on side slopes and along the head of drainageways. It is in irregularly shaped areas about 10 to 50 acres in size. It has the profile described as representative of the series.

Included with this soil in mapping are areas of Armstrong soils. These areas make up about 10 percent of the mapped acreage.

Runoff is rapid. If this soil is cultivated or is left without a cover crop, erosion is a hazard. Farming on the contour helps to control erosion.

This soil is suited to grasses and legumes used for hay. Capability unit IVe–1.

GaE—Gara loam, 14 to 20 percent slopes. This soil is on side slopes in irregularly shaped areas about 10 to 40 acres in size. It has a profile similar to the one described as representative of the series, but the surface layer is a few inches thinner.

Included with this soil in mapping are areas of Lindley soils and small areas of steep Gara soils. The areas of Lindley soils make up about 10 percent of the mapped acreage. Also included are areas of severely eroded Lindley soils. These areas are shown on the soil map by an erosion symbol that represents 2 acres.

Runoff is rapid. Using minimum tillage helps to control erosion. If this soil is cultivated, erosion is a hazard.

This soil is better suited to permanent pasture than to other uses. Capability unit VIe–1.

Gifford Series

The Gifford series consists of deep, somewhat poorly drained, gently sloping and moderately sloping soils on the sides of stream terraces. These soils formed in silty and clayey material overlying alluvial sediment. The native vegetation was tall prairie grasses.

In a representative profile the surface layer is very dark gray silt loam about 7 inches thick. The subsoil is about 49 inches thick. It is dark-gray, dark grayish-brown, and grayish-brown, very firm silty clay in the upper part; and grayish-brown and dark-gray, firm silty clay loam and clay loam in the lower part. The underlying material is yellowish-brown loamy sand.

Gifford soils have very slow permeability. Available water capacity is high. Organic-matter content is moderate, and natural fertility is medium. Erosion is a severe hazard.

These soils are used for crops commonly grown in the survey area.

Representative profile of Gifford silt loam, 2 to 5 percent slopes, in a cultivated field, 150 feet east and 100 feet south of the northwest corner of SW¼ sec. 13, T. 63 N., R. 11 W., in Knox County:

Ap—0 to 7 inches, very dark gray (10YR 3/1) silt loam; moderate, fine, granular structure; friable; many fine roots; medium acid; clear, smooth boundary.

B1t—7 to 9 inches, mottled, dark-gray (10YR 4/1) and dark grayish-brown (10YR 4/2) silty clay loam; weak, fine, subangular blocky structure; firm; few fine roots; thin discontinuous clay films; strongly acid; clear, smooth boundary.

B21t—9 to 23 inches, grayish-brown (2.5Y 5/2) silty clay; common, fine, distinct, strong-brown (7.5YR 5/6) and yellowish-brown (10YR 5/6) mottles; moderate, fine, subangular blocky structure; very firm; few fine roots; thin discontinuous clay films; medium acid; clear, smooth boundary.

B22t—23 to 30 inches, grayish-brown (2.5Y 5/2) silty clay; few, fine, distinct, strong-brown (7.5YR 5/6) and many, medium, distinct, reddish-brown (5YR 4/4) mottles; moderate, fine, subangular blocky structure; very firm; few medium roots; thin discontinuous clay films; black (10YR 2/1) oxide stains; slightly acid; clear, smooth boundary.

B31—30 to 38 inches, grayish-brown (2.5Y 5/2) silty clay loam; common, fine, distinct, strong-brown (7.5YR 5/8) and yellowish-red (5YR 4/6) mottles; moderate, fine, subangular blocky structure; firm; neutral; clear, smooth boundary.

B32—38 to 56 inches, dark-gray (10YR 4/1) clay loam; common, medium, distinct, dark-brown (7.5YR 4/4) mottles; weak, fine, subangular blocky structure and weak, thin, platy; firm; neutral; clear, smooth boundary.

IIC—56 to 68 inches, yellowish-brown (10YR 5/6) loamy sand; single grained; loose; neutral.

The Ap horizon is very dark gray or very dark grayish brown and is 7 to 9 inches thick. The B horizon is grayish-brown, dark-gray, or dark grayish-brown silty clay, silty clay loam, or clay loam.

Gifford soils formed in the same kind of material as Chariton and Auxvasse soils. They lack an A2 horizon, which is a prominent characteristic of Chariton and Auxvasse soils.

GfB—Gifford silt loam, 2 to 5 percent slopes. This soil occurs on the sides of high benches of streams. It is in uniformly shaped areas about 5 to 30 acres in size. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Chariton soils. These areas make up about 10 percent of the mapped acreage.

Runoff is medium. Erosion is a moderate hazard. If the slope is long enough, constructing terraces helps to control erosion.

This soil is used for corn and soybeans. Capability unit IIe–5.

GfC—Gifford silt loam, 5 to 9 percent slopes. This soil occurs on the sides of high benches of streams. It is in uniformly shaped areas about 5 to 25 acres in size. It has a profile similar to the one described as representative of the series, but the surface layer is 2 to 3 inches thinner.

Included with this soil in mapping are areas of steeper Gifford soils. These areas make up about 5 percent of the mapped acreage. Also included are areas of soils that have a thinner, lighter colored surface layer.

Runoff is medium. Erosion is a severe hazard. If the slopes are long enough, constructing terraces helps to control erosion.

This soil is used for corn and soybeans. Capability unit IIIe–5.

Gorin Series

The Gorin series consists of deep, somewhat poorly drained, moderately sloping soils on ridgetops. These soils formed in thin loess overlying glacial till. The native vegetation was deciduous trees.

In a representative profile the surface layer is very dark gray silt loam about 2 inches thick. The subsurface layer is brown silt loam about 3 inches thick. The subsoil is about 66 inches thick. It is dark yellowish-brown, firm silty clay loam in the upper part; dark-brown and grayish-brown, very firm silty clay in the middle part; and grayish-brown and yellowish-brown, firm silty clay loam and clay loam in the lower part.

Gorin soils have slow permeability. Available water capacity is high. Organic-matter content is low. Erosion is the main hazard.

These soils are used for hay, pasture, or woodland.

Representative profile of Gorin silt loam, 5 to 9 percent slopes, eroded, in a wooded area, 1,200 feet west and 1,000 feet north of the southeast corner of NE¼ sec. 9, T. 62 N., R. 10 W., in Knox County:

A1—0 to 2 inches, very dark gray (10YR 3/1) silt loam; moderate, very fine, granular structure; friable; many fine roots; neutral; abrupt, smooth boundary.

A2—2 to 5 inches, brown (10YR 5/3) silt loam; weak, thin, platy structure and moderate, very fine, granular; friable; many fine roots; very strongly acid; abrupt, smooth boundary.

B1t—5 to 12 inches, dark yellowish-brown (10YR 4/4) medium silty clay loam; moderate, fine, subangular blocky structure; firm; few medium roots; thin discontinuous clay films; very strongly acid; gradual, smooth boundary.

B21t—12 to 20 inches, dark-brown (10YR 4/3) medium silty clay; few, fine, faint, grayish-brown (10YR 5/2) mottles; moderate, fine, subangular blocky structure; very firm; few medium roots; thin continuous clay films; very strongly acid; gradual, smooth boundary.

B22t—20 to 28 inches, grayish-brown (10YR 5/2) medium silty clay; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; moderate, fine, subangular blocky structure; very firm; thin continuous clay films; very strongly acid; gradual, smooth boundary.

IIB31t—28 to 40 inches, grayish-brown (10YR 5/2) silty clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, fine, subangular blocky structure; firm; thin discontinuous clay films; moderate content of coarse sand; very strongly acid; gradual, smooth boundary.

IIB32t—40 to 71 inches, yellowish-brown (10YR 5/6) clay loam; common, medium, distinct, grayish-brown (10YR 5/2) mottles; weak, fine, subangular blocky structure and structureless; firm; thin discontinuous clay films; very strongly acid.

The A1 horizon is very dark gray, very dark grayish brown, dark grayish brown, or dark gray and ranges from 2 to 5 inches in thickness. The A2 horizon is brown or grayish brown and ranges from 2 to 5 inches in thickness. The B horizon is dark yellowish brown, yellowish brown, dark brown, or grayish brown.

Gorin soils are near Marion and Keswick soils on the landscape. They have a thinner A2 horizon than Marion soils. They lack red colors, which are characteristic of Keswick soils.

GoC2—Gorin silt loam, 5 to 9 percent slopes, eroded. This soil is on the sides and tops of narrow ridges. It occurs throughout the survey area in irregularly shaped areas about 5 to 25 acres in size.

Included with this soil in mapping are areas of Keswick soils. These areas make up about 10 percent of the mapped acreage.

Runoff is medium. Erosion is a severe hazard. In cleared areas, constructing terraces helps to control erosion.

In places this soil has been cleared of trees. The cleared areas are used for hay or pasture. Capability unit IIIe-5.

Gosport Series

The Gosport series consists of deep, moderately well drained, moderately sloping to moderately steep soils. These soils formed in shale fragments. The native vegetation was deciduous trees.

In a representative profile the surface layer is dark-brown silty clay loam about 5 inches thick. The subsoil is about 45 inches thick. It is yellowish-brown, gray, yellowish-red, and red, very firm silty clay in the upper part and dark grayish-brown and olive, very firm clay in the lower part. The underlying material is light greenish-gray, very dark gray, and olive-gray, very firm clay and silty clay.

Gosport soils have very slow permeability. Available water capacity is moderate. Organic-matter content and natural fertility are low.

These soils are used for hay or pasture.

Representative profile of Gosport silty clay loam, 5 to 9 percent slopes, in a pasture, 350 feet north and 155 feet east of the southwest corner NE¼NE¼ sec. 24, T. 55 N., R. 12 W., in Monroe County:

Ap—0 to 5 inches, dark-brown (10YR 4/3) light silty clay loam; weak, fine, subangular blocky structure; firm; many fine roots; slightly acid; clear, smooth boundary.

B21t—5 to 19 inches, yellowish-brown (10YR 5/6) silty clay; moderate, fine, subangular blocky structure; very firm; few fine roots; thin discontinuous clay films; strongly acid; gradual, smooth boundary.

B22t—19 to 28 inches, mottled, gray (5Y 6/1), yellowish-red (5YR 4/6), and red (10R 4/6) silty clay; moderate, medium, subangular blocky structure; very firm; few fine roots; thin discontinuous clay films; medium acid; clear, smooth boundary.

B23t—28 to 34 inches, dark grayish-brown (2.5Y 4/2) clay; few, medium, distinct, strong-brown (7.5YR 5/8), few, fine, distinct, yellowish-brown (10YR 5/6), and few, fine, prominent, red (2.5YR 4/6) mottles; weak, medium, subangular blocky structure; very firm; few fine roots; thin discontinuous clay films; strongly acid; clear, smooth boundary.

B24—34 to 50 inches, olive (5Y 5/3) clay; few, medium, distinct, yellowish-brown (10YR 5/8) and many, medium, distinct, strong-brown (7.5YR 5/8) mottles in lower 3 inches; weak, medium, subangular blocky structure; very firm; few fine roots; thin discontinuous clay films; strongly acid; clear, smooth boundary.

C1—50 to 59 inches, light greenish-gray (5GY 7/1) clay; few, fine, distinct, strong-brown (7.5YR 5/8) mottles; moderate, thin, platy structure; very firm; very strongly acid; clear, smooth boundary.

C2—59 to 64 inches, very dark gray (N 3/0) clay; dark-brown (10YR 4/3) and yellow (2.5Y 8/6) coatings; weak, thin, platy structure; very firm; very strongly acid; clear, smooth boundary.

C3—64 to 105 inches, olive-gray (5Y 5/2) silty clay; yellow (2.5YR 8/6) streaks; massive; very firm; very strongly acid.

The Ap horizon is dark brown or very dark gray and ranges from 2 to 5 inches in thickness. The B horizon ranges from 35 to 50 inches in thickness. The C horizon is greenish gray, very dark gray, olive gray, or very dark grayish brown.

Gosport soils are near Keswick and Lindley soils on the landscape. They formed in soft shale, and Keswick and

Lindley soils formed in glacial till. They have thicker layers, a more strongly developed B horizon, and redder mottles than the defined range for the Gosport series.

GpC—Gosport silty clay loam, 5 to 9 percent slopes. This soil is on the sides and convex tops of ridges. It has the profile described as representative of the series.

Included with this soil in mapping are areas of Calwoods soil. These areas make up about 10 percent of the mapped acreage.

Runoff is rapid. Erosion is a severe hazard. Constructing terraces helps to control erosion.

This soil is used mainly for hay and pasture. Some small areas are used for row crops commonly grown in the survey area. Capability unit IVe–7.

GpD—Gosport silty clay loam, 9 to 14 percent slopes. This soil is on side slopes in irregularly shaped areas about 10 to 20 acres in size. It has a profile similar to the one described as representative of the series, but the surface layer is a few inches thinner.

Included with this soil in mapping are areas of less sloping Gosport soil. These areas make up about 10 percent of the mapped acreage. Also included are small areas of soils that have a surface layer of loam and a subsoil of clay loam. A few limestone and shale rocks are exposed in places.

Runoff is rapid. Erosion is a severe hazard. Maintaining a good cover of grass helps to control erosion.

This soil is used mainly for pasture. Capability unit VIe–7.

GpE—Gosport silty clay loam, 14 to 20 percent slopes. This soil is on side slopes along drainageways. It is in irregularly shaped areas 10 to 20 acres in size. It has a profile similar to the one described as representative of the series, but the surface layer is a few inches thinner.

Included with this soil in mapping are areas of less sloping soils. These areas make up about 10 percent of the mapped acreage. Also included are small areas of soils that have a surface layer of loam and a subsoil of clay loam. Few to many limestone and shale rocks are exposed.

Runoff is rapid. Erosion is a very severe hazard. Maintaining stands of trees and a cover of grass helps to control erosion.

This soil is used mainly for woodland, but some areas are in pasture. Capability unit VIIe–7.

Goss Series

The Goss series consists of deep, well-drained, steep soils on the sides and tops of ridges. These soils formed in cherty silty and clayey material. The native vegetation was deciduous trees.

In a representative profile the surface layer is dark grayish-brown, cherty silt loam about 6 inches thick. The subsurface layer is brown, cherty silt loam about 13 inches thick. The subsoil is reddish-brown, red, and yellowish-brown, very firm cherty silty clay about 44 inches thick. The underlying material is light-gray clay.

Goss soils have moderate permeability. Available water capacity is low. Organic-matter content and natural fertility are low. Erosion is the main hazard.

Most areas of this soil are in woodland.

Representative profile of Goss cherty silt loam, 20 to 30 percent slopes, in a wooded area, 50 feet east and 180 feet north of the southwest corner of NW¼ sec. 15, T. 54 N., R. 9 W., in Monroe County:

A1—0 to 6 inches, dark grayish-brown (10YR 4/2) cherty silt loam; moderate, fine, granular structure; very friable; many fine roots; 15 percent chert fragments; medium acid; abrupt, smooth boundary.

A2—6 to 19 inches, brown (10YR 5/3) cherty silt loam; weak, fine, granular structure; very friable; many roots; 65 percent chert fragments; medium acid; gradual, smooth boundary.

B21t—19 to 28 inches, reddish-brown (5YR 4/4) and red (2.5YR 4/6) cherty silty clay; moderate, fine, subangular blocky structure; firm; few medium roots; 65 percent chert fragments; thin discontinuous clay films on face of peds; medium acid; clear, smooth boundary.

B22t—28 to 43 inches, red (2.5YR 4/6) cherty silty clay; many, medium, prominent, brown (10YR 5/3) mottles; moderate, fine, angular and subangular blocky structure; very firm; few medium roots; 30 percent chert fragments; thin discontinuous clay films on face of peds; strongly acid; clear, smooth boundary.

B23t—43 to 54 inches, red (2.5YR 4/6) cherty silty clay; few, medium, distinct, grayish-brown (10YR 5/2) mottles; moderate, fine, subangular blocky structure; very firm; 30 percent chert fragments; thin discontinuous clay films on face of peds; strongly acid; clear, smooth boundary.

B24t—54 to 63 inches, yellowish-brown (10YR 5/6) cherty silty clay; common, medium, prominent, red (2.5YR 4/6) mottles; weak, fine, subangular blocky structure; very firm; 45 percent chert and limestone fragments; black (10YR 2/1) stains on face of peds; medium acid; clear, smooth boundary.

C—63 to 69 inches, light-gray (10YR 7/1) clay; many, medium, distinct, brownish-yellow (10YR 6/6) mottles; massive; very firm; neutral.

The A1 horizon is dark grayish brown, very dark gray, or dark gray and ranges from 2 to 6 inches in thickness. The B horizon is reddish brown, red, yellowish brown, strong brown, or brown and ranges from 40 to 60 inches in thickness. Content of chert fragments ranges from 15 to 70 percent throughout the profile.

Goss soils are near Keswick and Lindley soils on the landscape. They formed in cherty residuum, and Keswick and Lindley soils formed in glacial till.

GsF—Goss cherty silt loam, 20 to 30 percent slopes. This soil is on side slopes. It occurs mainly in the southern one-third of the survey area. The areas are irregular in shape and are about 10 to 25 acres in size.

Included with this soil in mapping are areas of Lindley soils. These areas make up about 10 percent of the mapped acreage. In the southeast part of Shelby County along the Salt River is an area of soils that have a thicker mantle of soil over the chert than this Goss soil. In places the surface layer to a depth of 20 to 30 inches is relatively free of chert.

Runoff is rapid. Erosion is a very severe hazard. Maintaining existing trees helps to control erosion.

This soil is used for woodland. Capability unit VIIs–9.

Keswick Series

The Keswick series consists of deep, moderately well drained, moderately sloping and strongly sloping soils on the sides and tops of ridges. These soils formed in glacial till. The native vegetation was deciduous trees.

In a representative profile the surface layer is dark-brown loam about 4 inches thick. The subsurface layer is pale-brown loam about 3 inches thick. The subsoil is about 41 inches thick. It is strong-brown, firm loam and yellowish-red, firm clay loam in the upper part; red and strong-brown, very firm clay in the middle part; and yellowish-brown, firm clay loam in the lower part. The underlying material is dark yellowish-brown clay loam.

Keswick soils have slow permeability. Available water capacity is moderate. Organic-matter content and natural fertility are low. Erosion is the main hazard.

Part of the acreage is used for row crops, and some is used for hay. A few small areas are in woodland.

Representative profile of Keswick loam, 5 to 9 percent slopes, eroded, in a small wooded area, 1,320 feet south and 50 feet east of the northwest corner of SE¼ sec. 1, T. 54 N., R. 10 W., in Monroe County:

A1—0 to 4 inches, dark-brown (10YR 4/3) loam; moderate, very fine, granular structure; friable; many fine roots; medium acid; abrupt, smooth boundary.

A2—4 to 7 inches, pale-brown (10YR 6/3) loam; weak, thin, platy and moderate, fine, granular structure; friable; many fine roots; strongly acid; abrupt, smooth boundary.

B1—7 to 12 inches, strong-brown (7.5YR 5/6) loam; fine, subangular blocky structure; firm; few medium roots; very strongly acid; clear, smooth boundary.

B21t—12 to 19 inches, yellowish-red (5YR 4/6) clay loam; few, fine, distinct, yellowish-brown (10YR 5/4) mottles; weak, fine, subangular blocky structure; firm; few medium roots; thin continuous clay films; very strongly acid; clear, smooth boundary.

B22t—19 to 28 inches, red (2.5YR 4/6) clay; many, fine, distinct, gray (10YR 5/1) mottles; moderate, fine, subangular blocky structure; very firm; few medium roots; thin continuous clay films; very strongly acid; clear, smooth boundary.

B23t—28 to 36 inches, strong-brown (7.5YR 5/6) clay; few, fine, distinct, dark grayish-brown (10YR 4/2) mottles; moderate, fine, subangular blocky structure; very firm; few medium roots; thin continuous clay films; strongly acid; clear, smooth boundary.

B3—36 to 48 inches, yellowish-brown (10YR 5/6) clay loam; common, fine, distinct, grayish-brown (10YR 5/2) mottles; moderate, fine, subangular blocky structure; firm; slightly acid; abrupt, smooth boundary.

C—48 to 60 inches, dark yellowish-brown (10YR 4/4) light clay loam; massive; firm; mildly alkaline.

The A1 horizon is dark brown or dark grayish brown and ranges from 2 to 5 inches in thickness. The A2 horizon is pale brown, dark grayish brown, or brown and ranges from 2 to 5 inches in thickness. The B horizon is strong brown, yellowish red, red, grayish brown, or yellowish brown.

Keswick soils formed in the same kind of material as Lindley and Armstrong soils. They have a thinner A1 horizon than Armstrong soils. They have red colors in the B horizon that are lacking in Lindley soils.

KeC2—Keswick loam, 5 to 9 percent slopes, eroded. This soil is on the sides and convex tops of ridges. It is in irregularly shaped areas about 5 to 35 acres in size. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Lindley and Armstrong soils. These areas make up about 10 percent of the mapped acreage. Also included are areas of a severely eroded Keswick soil that make up less than 1 percent of the mapped acreage. These areas are shown on the soil map by an erosion symbol that represents 2 acres.

Runoff is medium. If this soil is cultivated, erosion is a hazard. Constructing terraces helps to control erosion.

This soil is used for corn, soybeans, wheat, alfalfa, and red clover. Some areas have not been cleared of trees. Capability unit IIIe-5.

KeD2—Keswick loam, 9 to 14 percent slopes, eroded. This soil is on side slopes in irregularly shaped areas about 5 to 20 acres in size. It has a profile similar to the one described as representative of the series, but the surface layer is about 2 inches thinner.

Included with this soil in mapping are small areas of Lindley soils and some small areas of moderately sloping Keswick soils. The areas of Lindley soils make up about 10 percent of the mapped acreage. Also included are areas of severely eroded Keswick soil that make up less than 1 percent of the mapped acreage. These areas are shown on the soil map by an erosion symbol that represents 2 acres.

Runoff is rapid. If this soil is cultivated, erosion is a hazard. Using minimum tillage during reseeding helps to control erosion.

Cleared areas of this soil are used for hay. Capability unit IVe-5.

Kickapoo Series

The Kickapoo series consists of deep, moderately well drained, level and nearly level soils on flood plains. These soils formed in sandy alluvial sediment. The native vegetation was deciduous trees.

In a representative profile the surface layer is dark grayish-brown, fine sandy loam about 9 inches thick. The underlying material is dark-brown, fine sandy loam.

Kickapoo soils have moderately rapid permeability. Available water capacity is high. Organic-matter content and natural fertility are low.

These soils are used for row crops. Flooding is the main limitation.

Representative profile of Kickapoo fine sandy loam, in a small idle field, 25 feet south and 220 feet west of the northeast corner of sec. 28, T. 56 N., R. 9 W., in Monroe County:

A1—0 to 9 inches, dark grayish-brown (10YR 4/2) fine sandy loam; weak, very fine, granular structure; loose; friable; few fine roots; slightly acid; gradual, smooth boundary.

C1—9 to 19 inches, dark-brown (10YR 3/3) fine sandy loam; weak, fine, granular structure; friable; few medium roots; slightly acid; gradual, smooth boundary.

C2—19 to 44 inches, dark-brown (10YR 4/3) fine sandy loam; weak, fine, subangular blocky structure; friable; strongly acid; clear, smooth boundary.

C3—44 to 65 inches, dark-brown (10YR 4/3) fine sandy loam; common, medium, distinct, gray (10YR 6/1) mottles; weak, fine, subangular structure; friable; strongly acid.

The A1 horizon is dark grayish brown or dark brown and is 7 to 9 inches thick. The C horizon is dark grayish brown or dark brown.

Kickapoo soils are near Blackoar and Piopolis soils on the landscape. They are not so gray as Blackoar or Piopolis soils, and they are sandier than those soils.

Kk—Kickapoo fine sandy loam. This nearly level soil is on flood plains. Included in mapping are small areas of Blackoar and Piopolis soils. These areas make up about 10 percent of the mapped acreage.

Runoff is slow. Droughtiness is a severe limitation. This soil is subject to flooding.

This soil is suited to wheat and a limited amount of corn and soybeans. Capability unit IIIs–1.

Kilwinning Series

The Kilwinning series consists of deep, somewhat poorly drained, gently sloping soils on the sides and tops of ridges. These soils formed in silty and clayey material. The native vegetation was mixed prairie grasses.

In a representative profile the surface layer is very dark gray silt loam about 7 inches thick. The subsoil is about 33 inches thick. It is dark-gray, dark grayish-brown, and grayish-brown, very firm silty clay in the upper part and gray, firm silty clay loam in the lower part. The underlying material is yellowish-brown, friable silt loam.

Kilwinning soils have very slow permeability. Available water capacity is high. Organic-matter content is moderate, and natural fertility is high. Erosion is the main hazard.

These soils are used for all crops commonly grown in the survey area.

Representative profile of Kilwinning silt loam, 2 to 5 percent slopes, in a cultivated field, 800 feet north and 500 feet east of the southwest corner of NW¼ sec. 28, T. 62 N., R. 12 W., in Knox County:

Ap—0 to 7 inches, very dark gray (10YR 3/1) silt loam; gray (10YR 5/1), dry; moderate, fine, granular structure; friable; few fine roots; neutral; abrupt, smooth boundary.

B1t—7 to 13 inches, dark-gray (10YR 4/1) light silty clay; common, fine, distinct, strong-brown (7.5YR 5/6) mottles; moderate, fine, subangular blocky structure; very firm; few fine roots; thin continuous clay films; medium acid; gradual, smooth boundary.

B21t—13 to 20 inches, dark grayish-brown (10YR 4/2) medium silty clay; few, fine, faint, gray (10YR 5/1) and few, fine, distinct, strong-brown (7.5YR 5/6) mottles; moderate, fine, subangular blocky structure; very firm; few fine roots; thin discontinuous clay films; strongly acid; gradual, smooth boundary.

B22t—20 to 28 inches, grayish-brown (2.5Y 5/2) medium silty clay; common, fine, distinct, strong-brown (7.5YR 5/6) mottles; few black (10YR 2/1) concretions of oxides; moderate, fine, subangular blocky structure; very firm; few fine roots; thin continuous clay films; slightly acid; gradual, smooth boundary.

B3t—28 to 40 inches, gray (10YR 5/1) heavy silty clay loam; few, medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, fine, subangular blocky structure; firm; few black (10YR 2/1) oxide stains; neutral; clear, smooth boundary.

C—40 to 60 inches, yellowish-brown (10YR 5/6) silt loam; few, medium, distinct, gray (10YR 6/1) mottles; moderate, fine, granular structure; friable; neutral.

The Ap horizon is very dark gray or very dark grayish brown and is 7 to 9 inches thick. The B horizon ranges from silty clay loam to silty clay.

Kilwinning soils are near Leonard and Putnam soils on the landscape. They are browner and contain less clay below a depth of 40 inches than Leonard soils. They lack an A2 horizon, which is present in Putnam soils.

KlB—Kilwinning silt loam, 2 to 5 percent slopes. This soil is on the sides and convex tops of ridges. It is in irregularly shaped areas about 15 to 80 acres in size.

Included with this soil in mapping are areas of Leonard soils. These areas make up about 10 percent of the mapped acreage. Also included in places are very small areas of Putnam silt loam.

Runoff is medium. Both sheet and rill erosion are hazards on this soil. Constructing terraces helps to control erosion.

This soil is used mainly for corn and soybeans. Capability unit IIe–5.

Leonard Series

The Leonard series consists of deep, somewhat poorly drained, moderately sloping and strongly sloping soils on side slopes. These soils formed in silty and clayey material. The native vegetation was mixed prairie grasses.

In a representative profile the surface layer is very dark grayish-brown silt loam about 7 inches thick. The subsoil is dark grayish-brown silty clay loam and grayish brown and gray, very firm silty clay about 71 inches thick.

Leonard soils have slow permeability. Available water capacity is moderate. Organic-matter content is moderate, and natural fertility is high. Erosion is the main hazard.

These soils are used for row crops and hay.

Representative profile of Leonard silt loam, 5 to 9 percent slopes, eroded, in a cultivated field, 170 feet west and 190 feet north of the southeast corner of SW¼ sec. 20, T. 57 N., R. 11 W., in Shelby County:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam; grayish brown (10YR 5/2), dry; moderate, fine, granular structure; friable; few fine roots; neutral; abrupt, smooth boundary.

B1—7 to 12 inches, dark grayish-brown (10YR 4/2) medium silty clay loam; few, fine, distinct, strong-brown (7.5YR 5/6) mottles; moderate, fine, subangular blocky structure; firm; few fine roots; strongly acid; gradual, smooth boundary.

B21t—12 to 17 inches, grayish-brown (10YR 5/2) light silty clay; strong brown (7.5YR 5/6), kneaded; common, fine, distinct, yellowish-red (5YR 4/6) mottles; moderate, fine, subangular blocky structure; very firm; thin continuous clay films; slightly acid; gradual, smooth boundary.

B22t—17 to 33 inches, gray (10YR 5/1) medium silty clay; strong brown (7.5YR 5/6), kneaded; common, fine, distinct, yellowish-red (5YR 4/6) mottles; moderate, fine, subangular blocky structure; very firm; thin continuous clay films; few, fine, white fragments of chert; very strongly acid; gradual, smooth boundary.

B23t—33 to 40 inches, gray (10YR 6/1) medium silty clay; pale brown (10YR 6/3), kneaded; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, fine, subangular blocky structure; very firm; thin continuous clay films; few, fine, white fragments of chert; few grains of sand; medium acid; clear, smooth boundary.

B3t—40 to 78 inches, gray (5Y 5/1) medium silty clay; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, angular and subangular blocky structure; very firm; thin continuous clay films; black (10YR 2/1) oxide stains; few, fine, white fragments of chert; very fine sand; neutral.

The Ap horizon is very dark grayish brown or very dark gray and is 7 to 9 inches thick. The B horizon ranges from silty clay loam to clay.

Leonard soils are near Mexico and Armstrong soils on the landscape. They have more clay below a depth of 40 inches than Mexico soils. They are grayer than Armstrong soils.

LcC2—Leonard silt loam, 5 to 9 percent slopes, eroded. This soil is on side slopes and along the head of drainageways. It is in irregularly shaped areas about 10 to 40 acres in size. It has the profile described as representative of the series.

Included with this soil in mapping are areas of Armstrong, Kilwinning, and Mexico soils. These areas make up about 10 percent of the mapped acreage. Also included is a small percentage of severely eroded areas of Keswick soil. These areas are shown on the soil map by an erosion symbol that represents 2 acres.

Runoff is medium. If this soil is cultivated, erosion is a hazard. Constructing terraces helps to control erosion.

This soil is used for corn, soybeans, wheat, and red clover. Capability unit IIIe–5.

LcD2—Leonard silt loam, 9 to 14 percent slopes, eroded. This soil is on side slopes in irregularly shaped areas about 10 to 20 acres in size. It has a profile similar to the one described as representative of the series, but the surface layer is a few inches thinner.

Included with this soil in mapping are small areas of Armstrong soils. These areas make up about 10 percent of the mapped acreage. Also included are areas of severely eroded Leonard soil that make up a small percentage of the mapped area. These areas are shown on the soil map by an erosion symbol that represents 2 acres.

Runoff is rapid. If this soil is cultivated, erosion is a hazard. Constructing terraces and using minimum tillage helps to control erosion.

This soil is used mainly for hay. Some areas are used for corn and soybeans. Capability unit IVe–5.

Lindley Series

The Lindley series consists of deep, well-drained, moderately steep and steep soils on uplands. These soils formed in glacial till. The native vegetation was deciduous trees.

In a representative profile the surface layer is dark-gray loam about 2 inches thick. The subsurface layer is brown loam about 6 inches thick. The subsoil is yellowish-brown and strong-brown, firm clay loam about 40 inches thick. The underlying material is strong-brown loam.

Lindley soils have moderately slow permeability. Available water capacity is high. Organic-matter content and natural fertility are low. Erosion is the main hazard.

These soils are used mainly for woodland or pasture.

Representative profile of Lindley loam, 14 to 20 percent slopes, in a wooded area, in the southwest corner of SW¼NE¼ sec. 2, T. 62 N., R. 10 W., in Knox County:

A1—0 to 2 inches, dark-gray (10YR 4/1) loam; moderate, very fine, granular structure; friable; few fine roots; very strongly acid; abrupt, smooth boundary.

A2—2 to 8 inches, brown (10YR 5/3) loam; moderate, thin, platy structure breaking to moderate, very fine, granular; friable; few fine roots; very strongly acid; abrupt, smooth boundary.

B1—8 to 11 inches, yellowish-brown (10YR 5/6) heavy loam; moderate, fine, angular and subangular blocky structure; firm; few fine roots; light-gray (10YR 7/2) coatings of silt; very strongly acid; clear, smooth boundary.

B21t—11 to 19 inches, yellowish-brown (10YR 5/6) light clay loam; moderate, fine, subangular blocky structure; firm; few fine roots; thin continuous clay films; very strongly acid; gradual, smooth boundary.

B22t—19 to 26 inches, yellowish-brown (10YR 5/6) clay loam; common, fine, distinct, light brownish-gray (10YR 6/2) and few, fine, distinct, strong-brown (7.5YR 5/6) mottles; moderate, fine, subangular blocky structure; firm; few fine roots; thin continuous clay films; very strongly acid; gradual, smooth boundary.

B3t—26 to 48 inches, strong-brown (7.5YR 5/6) light clay loam; common, medium, distinct, light brownish-gray (2.5Y 6/2) mottles; weak, fine, subangular blocky structure; firm; few fine roots; black (10YR 2/1) oxide stains; very strongly acid; gradual, smooth boundary.

C—48 to 82 inches, strong-brown (7.5YR 5/6) heavy loam; few, fine, distinct, gray (10YR 6/1) mottles; massive; friable; few fine roots; black (10YR 2/1) organic stains; neutral.

The A1 horizon is very dark gray, dark grayish brown, dark gray, or grayish brown and is 2 to 4 inches thick. The A2 horizon is brown, grayish brown, or dark grayish brown and ranges from 3 to 6 inches in thickness. The B horizon ranges from 35 to 50 inches in thickness.

Lindley soils formed in the same kind of material as Keswick and Gara soils. They lack a red color in the B horizon, which is characteristic of Keswick soils. They have a thinner A1 horizon than Gara soils.

LdE—Lindley loam, 14 to 20 percent slopes. This soil is on side slopes in irregularly shaped areas about 10 to 40 acres in size. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Gara soils, which make up about 5 percent of the mapped acreage.

Runoff is rapid. Erosion is a hazard on this soil. Using minimum tillage when reseeding helps to control erosion.

Many areas of this soil have been cleared for permanent pasture. Capability unit VIe–4.

LdF—Lindley loam, 20 to 30 percent slopes. This soil is on the sides and convex tops of ridges. It is in irregularly shaped areas about 20 to 60 acres in size.

Included with this soil in mapping are areas of Goss soils. Also included are areas of eroded Lindley soils that make up about 10 percent of the mapped acreage.

Runoff is rapid. This soil is susceptible to erosion. Maintaining a good cover of grass and trees helps to control erosion.

This soil is in permanent pasture or woodland, and it is well suited to these uses. Capability unit VIIe–4.

Marion Series

The Marion series consists of deep, poorly drained, nearly level soils on uplands. These soils formed in silty and clayey material. The native vegetation was deciduous trees.

In a representative profile the surface layer is dark grayish-brown silt loam about 3 inches thick. The subsurface layer is grayish-brown silt loam about 9 inches thick. The subsoil is about 48 inches thick. It is yellowish-brown and grayish-brown, very firm silty clay in the upper part and grayish-brown and light brownish-gray, firm silty clay loam in the lower part.

Marion soils have very slow permeability. Available water capacity is high. Organic-matter content and natural fertility are low. Wetness and a hazard of erosion are limitations.

Representative profile of Marion silt loam, 0 to 2 percent slopes, in a small wooded area, 255 feet west and 550 feet north of the southeast corner of NE¼ sec. 9, T. 62 N., R 10 W., in Knox County:

A1—0 to 3 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, fine, granular structure; friable; many fine roots; neutral; abrupt, smooth boundary.

A2—3 to 12 inches, grayish-brown (10YR 5/2) silt loam; moderate, medium, platy and moderate, fine, granular structure; friable; many fine roots; very strongly acid; abrupt, smooth boundary.

B21t—12 to 24 inches, yellowish-brown (10YR 5/4) silty clay; few, fine, faint, grayish-brown (10YR 5/2) mottles; moderate, fine, subangular blocky structure; very firm; few medium roots; thin continuous clay films; strongly acid; gradual, smooth boundary.

B22t—24 to 30 inches, grayish-brown (10YR 5/2) silty clay; common, fine, distinct, yellowish-brown (10YR 5/4) mottles; moderate, fine, subangular blocky structure; very firm; thin continuous clay films; strongly acid; clear, smooth boundary.

B31t—30 to 36 inches, grayish-brown (10YR 5/2) silty clay loam; common, fine, distinct, dark-brown (7.5YR 4/4) mottles; weak, fine, subangular blocky structure; firm; thin discontinuous clay films; strongly acid; gradual, smooth boundary.

B32—36 to 60 inches, light brownish-gray (10YR 6/2) light silty clay loam; common, fine, distinct, yellowish-brown (10YR 5/8) mottles; massive; firm; few black (10YR 2/1) concretions of oxides; strongly acid.

The A1 horizon is dark grayish brown, grayish brown, or very dark grayish brown and is 1 to 3 inches thick. The A2 horizon is grayish brown or light brownish gray and ranges from 6 to 10 inches in thickness. The B horizon is yellowish brown or grayish brown and has strong-brown or dark-brown mottles.

Marion soils formed in the same kind of material as Calwoods and Mexico soils. They lack red mottles, which are characteristic of Calwoods and Mexico soils. They have a thinner A1 horizon than Mexico soils.

MaA—Marion silt loam, 0 to 2 percent slopes. This soil is on uplands in irregularly shaped areas about 3 to 5 acres in size. It has the profile described as representative of the series.

Runoff is slow. Wetness is a severe limitation. Removing excess water is generally not practical, because areas are small.

Most areas are in woodland. If cleared of trees, this soil is suited to hay or pasture. Trees do not produce very well, because roots can penetrate only to a moderate depth. Capability unit IIIw–2.

MaB—Marion silt loam, 2 to 5 percent slopes. This soil is on the sides of high benches of streams. Slopes are generally short. This soil occurs in uniformly shaped areas about 3 to 15 acres in size. It has a profile similar to the one described as representative of the series, but the surface layer is generally a few inches thicker, the subsurface layer is a few inches thinner in places, and the upper part of the subsoil is brighter colored.

Included with this soil in mapping are small areas of Auxvasse soils. These areas make up about 10 percent of the mapped acreage.

Runoff is medium. Erosion is a severe hazard.

This soil is used for row crops where adjacent soils are used for row crops. Some areas are used for hay or permanent pasture. Capability unit IIIe–5.

Mexico Series

The Mexico series consists of deep, somewhat poorly drained, gently sloping soils on uplands. These soils formed in silty and clayey materials. The native vegetation was mixed prairie grasses.

In a representative profile the surface layer is very dark grayish-brown silt loam about 8 inches thick. The subsoil is about 66 inches thick. It is grayish-brown, firm silty clay loam in the upper part; dark-gray, gray, and yellowish-red, very firm silty clay in the middle part; and gray, firm silty clay loam and friable silt loam in the lower part.

Mexico soils have very slow permeability. Available water capacity is high. Organic-matter content is moderate, and natural fertility is medium.

These soils are used for row crops. Erosion is the main hazard.

Representative profile of Mexico silt loam, 2 to 5 percent slopes, in a cultivated field, 50 feet west and 1,000 feet south of the northeast corner of sec. 34, T. 57 N., R. 10 W., in Shelby County:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, fine, granular structure; friable; few fine roots; neutral; clear, smooth boundary.

B1t—8 to 12 inches, grayish-brown (10YR 5/2) silty clay loam; common, fine, distinct, yellowish-red (5YR 4/6) mottles; weak, fine, angular and subangular blocky structure; firm; few fine roots; thin continuous clay films; slightly acid; gradual, smooth boundary.

B21t—12 to 20 inches, mottled, dark-gray (10YR 4/1) and yellowish-red (5YR 5/6) silty clay; moderate, fine, subangular blocky structure; very firm; few fine roots; thin continuous clay films; strongly acid; gradual, smooth boundary.

B22t—20 to 30 inches, gray (10YR 5/1) silty clay; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, fine, subangular blocky structure; very firm; thin continuous clay films; medium acid; gradual, smooth boundary.

B31t—30 to 48 inches, gray (10YR 6/1) silty clay loam; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, fine and medium, subangular blocky structure; firm; thin continuous clay films; slightly acid; gradual, smooth boundary.

B32t—48 to 74 inches, gray (10YR 6/1) heavy silt loam; few, fine, distinct, strong-brown (7.5YR 5/6) mottles; weak, fine, subangular blocky structure; friable; thin discontinuous clay films; slightly acid.

The Ap horizon is very dark grayish brown or very dark gray and is 7 to 9 inches thick. The B horizon ranges from 50 to 70 inches in thickness.

Mexico soils formed in the same kind of material as Calwoods and Putnam soils. They have a thicker A1 horizon than Calwoods soils. They lack an A2 horizon, which is a prominent characteristic of Putnam soils.

MeB—Mexico silt loam, 2 to 5 percent slopes. This soil is on the sides and convex tops of ridges. It occurs in the southern two-thirds of the survey area in irregularly shaped areas about 10 to 80 acres in size. It has the profile described as representative of the series.

Included with this soil in mapping are areas of Leonard and Armstrong soils. These areas make up about 5 percent of the mapped acreage.

If this soil is cultivated, erosion is a hazard. Constructing terraces helps to control erosion. Both gully and rill erosion are hazards on this soil.

This soil is suited to corn, soybeans, wheat, and red clover. Capability unit IIe–5.

MeB2—Mexico silt loam, 2 to 5 percent slopes, eroded. This soil is on the sides and convex tops of ridges. It is mainly in the southern two-thirds of the survey area in irregularly shaped areas about 15 to 80 acres in size. It has a profile similar to the one described as representative of the series, but the surface layer is 2 to 3 inches thinner. In plowed areas, the surface layer consists of several inches of subsoil material mixed with material from the original surface layer.

Included with this soil in mapping are areas of Leonard and Armstrong soils. These areas make up about 10 percent of the mapped acreage.

Runoff is medium. If this soil is cultivated, further erosion is a hazard. Sheet and rill erosion are the most damaging types of erosion on this soil. Constructing terraces helps to control further erosion.

This soil is suited to crops commonly grown in the survey area, such as corn, soybeans, wheat, and red clover. Capability unit IIIe-5.

Moniteau Series

The Moniteau series consists of deep, poorly drained, nearly level soils on bottom lands. These soils formed in silty material. The native vegetation was deciduous trees.

In a representative profile the surface layer is dark-gray silt loam about 9 inches thick. The subsurface layer is gray silt loam about 8 inches thick. The subsoil is dark-gray and dark grayish-brown, firm silty clay loam about 26 inches thick. The underlying material is dark-gray silt loam.

Moniteau soils have slow permeability. Available water capacity is high. Organic-matter content is moderate, and natural fertility is low.

These soils are suited to row crops. Because flooding is frequent, many areas are in permanent pasture. Wetness is the main limitation.

Representative profile of Moniteau silt loam, in a permanent pasture, 150 feet west and 530 feet south of the northeast corner of sec. 14, T. 59 N., R. 12 W., in Shelby County:

Ap—0 to 9 inches, dark-gray (10YR 4/1) silt loam; few, fine, distinct, strong-brown (7.5YR 5/6) mottles; moderate, very fine, granular structure; friable; few roots; medium acid; abrupt, smooth boundary.

A2—9 to 17 inches, gray (10YR 6/1) silt loam; few, fine, distinct, yellowish-brown (10YR 5/4) mottles; moderate, thin, platy structure; friable; very strongly acid; abrupt, smooth boundary.

B21tg—17 to 27 inches, dark-gray (10YR 4/1) and dark grayish-brown (10YR 4/2) light silty clay loam; few, fine, faint, dark-brown (10YR 4/3) mottles; moderate, fine, subangular blocky structure; firm; black (10YR 2/1) clay flows; few, fine, thin, discontinuous clay films; few patchy coatings of silt; very strongly acid; clear, smooth boundary.

B22tg—27 to 43 inches, dark-gray (10YR 4/1) light silty clay loam; weak, fine, subangular blocky structure; firm; few, thin, discontinuous clay films; very strongly acid; gradual, smooth boundary.

C—43 to 78 inches, dark-gray (10YR 4/1) silt loam; few, fine, distinct, dark-brown (7.5YR 4/4) mottles; moderate, fine, granular structure; friable; very strongly acid.

The Ap horizon is dark gray or dark grayish brown and is 7 to 9 inches thick. The A2 horizon is gray or grayish brown and ranges from 8 to 11 inches in thickness. The B horizon is dark gray, dark grayish brown, grayish brown, or light brownish gray.

Moniteau soils are near Piopolis and Blackoar soils on the landscape. They have an A2 horizon, which is lacking in Piopolis soils. They have a lighter colored A horizon than Blackoar soils.

Mo—Moniteau silt loam. This level to nearly level soil is on low benches and in narrow valleys of streams. It is in irregularly shaped areas about 10 to 50 acres in size.

Included with this soil in mapping are areas of Piopolis and Arbela soils. These areas make up about 10 percent of the mapped acreage.

Runoff is slow. Wetness is a severe limitation because of flooding. Building levees to protect the soil from flooding is generally not practical, because areas are small.

Some areas of this soil are used for corn and soybeans, but other areas are used mainly for pasture because they are very irregular in shape and are subject to frequent flooding. Some areas are in woodland. Capability unit IIIw-2.

Piopolis Series

The Piopolis series consists of deep, poorly drained, nearly level soils on bottom lands. These soils formed in silty and clayey material. The native vegetation was deciduous trees.

In a representative profile the surface layer is dark-gray silty clay loam about 9 inches thick. The underlying material is grayish-brown and gray silty clay loam.

Piopolis soils have slow permeability. Available water capacity is high. Organic-matter content is moderate, and natural fertility is high.

These soils are used for row crops. Wetness is a limitation.

Representative profile of Piopolis silty clay loam, in a cultivated field, 500 feet west and 1,100 feet north of the southeast corner of sec. 23, T. 54 N., R. 12 W., in Monroe County:

Ap—0 to 9 inches, dark-gray (10YR 4/1) silty clay loam; moderate, fine, granular structure; friable; many fine roots; slightly acid; clear, smooth boundary.

C1—9 to 20 inches, grayish-brown (10YR 5/2) silty clay loam; few, fine, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/6) mottles; weak, thin, platy structure; firm; few fine roots; strongly acid; clear, smooth boundary.

C2—20 to 30 inches, grayish-brown (10YR 5/2) silty clay loam; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; firm; fine rounded concretions of oxides; strongly acid; clear, smooth boundary.

C3—30 to 40 inches, gray (10YR 5/1) silty clay loam; many, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, medium, subangular blocky structure; firm; fine rounded concretions of oxides; medium acid; clear, smooth boundary.

C4—40 to 62 inches, gray (10YR 5/1) silty clay loam; common, fine, distinct, strong-brown (7.5YR 5/6) mottles; massive; firm; medium acid.

The Ap horizon is dark gray or dark grayish brown and is 8 to 10 inches thick. The C horizon is gray, grayish brown, or dark grayish brown.

Piopolis soils are near Blackoar and Moniteau soils on the landscape. They have a lighter colored A horizon than Blackoar soils. They lack an A2 horizon, which is characteristic of Moniteau soils.

Po—Piopolis silty clay loam. This level and nearly level soil is on low benches of streams. It is in irregularly shaped areas about 20 to 80 acres in size.

Included with this soil in mapping are small areas of Arbela and Blackoar soils. These areas make up about 10 percent of the mapped acreage.

Runoff is slow. Wetness caused by flooding is a moderate limitation. Constructing levees helps to protect the soil from flooding.

This soil is suited to corn and soybeans. Capability unit IIw-1.

Putnam Series

The Putnam series consists of deep, poorly drained, nearly level soils on uplands. These soils formed in silty and clayey material. The native vegetation was mixed prairie grasses.

In a representative profile the surface layer is very dark grayish-brown silt loam about 9 inches thick. The subsurface layer is grayish-brown silt loam about 8 inches thick. The subsoil is about 36 inches thick. It is dark-gray, dark grayish-brown, and grayish-brown, very firm silty clay in the upper part and grayish-brown, firm silty clay loam in the lower part. The underlying material is gray silty clay loam.

Putnam soils have very slow permeability. Available water capacity is high. Organic-matter content is moderate, and natural fertility is high.

These soils are used mainly for row crops. Wetness is the main limitation.

Representative profile of Putnam silt loam, in a cultivated field, 1,250 feet south and 550 feet east of the northwest corner of SW1/4 sec. 17, T. 54 N., R. 11 W., in Monroe County:

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, fine, granular structure; friable; many fine roots; slightly acid; abrupt, smooth boundary.

A2—9 to 17 inches, grayish-brown (10YR 5/2) silt loam; few, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, thin, platy structure; friable; few fine roots; very strongly acid; abrupt, smooth boundary.

B21t—17 to 22 inches, dark-gray (10YR 4/1) silty clay; common, fine, distinct, red (2.5YR 4/6) and few, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, fine, angular and subangular blocky structure; very firm; thin continuous clay films; very strongly acid; gradual, smooth boundary.

B22t—22 to 28 inches, dark grayish-brown (10YR 4/2) silty clay; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; very firm; thin continuous clay films; strongly acid; gradual, smooth boundary.

B23t—28 to 34 inches, grayish-brown (2.5Y 5/2) silty clay; common, fine, distinct, strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; very firm; thin discontinuous clay films; very strongly acid; clear, smooth boundary.

B31t—34 to 42 inches, grayish-brown (2.5Y 5/2) silty clay loam; many, medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; firm; thin discontinuous clay films; very strongly acid; clear, smooth boundary.

B32t—42 to 53 inches, grayish-brown (2.5Y 5/2) silty clay loam; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; firm; thin discontinuous clay films; strongly acid; clear, smooth boundary.

C—53 to 80 inches, gray (10YR 5/1) light silty clay loam; few, medium, distinct, reddish-brown (5YR 4/4) mottles; massive; firm; medium acid.

The Ap horizon is very dark gray or very dark grayish brown and is 8 to 10 inches thick. The A2 horizon is gray or grayish brown and ranges from 6 to 9 inches in thickness. The B horizon is gray, dark gray, dark grayish brown, or grayish brown and ranges from 30 to 45 inches in thickness. The C horizon is gray or dark gray.

Putnam soils formed in the same kind of material as Mexico and Calwoods soils. They have a prominent A2 horizon that is lacking in Mexico soils. They have a thicker, darker colored A horizon than Calwoods soils.

Pu—Putnam silt loam. This nearly level soil is on wide upland divides. It is in uniformly shaped areas about 15 to 80 acres in size.

Runoff is slow. Wetness is a moderate limitation. Constructing drainage ditches and land grading or smoothing help to remove excess water. This soil is subject to ponding if it is not graded.

This soil is suited to crops commonly grown in the survey area, such as corn, soybeans, wheat, and red clover. If well managed it can be cropped intensively. Capability unit IIw-2.

Rock Land

Rk—Rock land is about 75 to 95 percent rock and 5 to 25 percent shallow soils over bedrock. It generally occupies ledges adjacent to large streams. It occurs mainly as large boulders or as chert rocks and fragments of limestone 4 to 12 inches in diameter. The soil material is generally light brownish gray to grayish brown and is generally 0 to 6 inches thick. Slopes range from 20 to 40 percent.

Runoff is rapid. Available water capacity is low. Droughtiness and the hazard of erosion are very severe limitations. Stands of trees help to control erosion.

In places Rock land is used for pasture and woodland, but it is better suited to wildlife habitat than to those uses. Capability unit VIIs-10.

Vigar Series

The Vigar series consists of deep, moderately well drained, gently sloping soils. These soils formed in glacial sediment eroded from upland slopes. The native vegetation was mixed prairie grasses.

In a representative profile the surface layer is very dark brown and very dark gray loam about 17 inches thick. The subsoil is about 44 inches thick. It is very dark grayish-brown, firm silty clay loam in the upper part; grayish-brown, firm clay loam in the middle part; and dark yellowish-brown, firm clay loam in the lower part.

Vigar soils have moderately slow permeability. Available water capacity is high. Organic-matter content is moderate, and natural fertility is high.

These soils are used for row crops or hay. Erosion is the main hazard.

Representative profile of Vigar loam, 2 to 5 percent slopes, in a small hayfield, 1,400 feet east and 150 feet south of the northwest corner of sec. 16, T. 59 N., R. 12 W., in Shelby County:

A11—0 to 10 inches, very dark brown (10YR 2/2) loam; moderate, fine, granular structure; friable; common fine roots; slightly acid; gradual, smooth boundary.

A12—10 to 17 inches, very dark gray (10YR 3/1) loam; moderate, fine, granular structure; friable; common fine roots; slightly acid; clear, smooth boundary.

B1—17 to 22 inches, very dark grayish-brown (10YR 3/2) silty clay loam; few, fine, faint, dark yellowish-brown (10YR 4/4) mottles; weak, fine, subangular blocky structure; firm; thin discontinuous clay films; medium acid; clear, smooth boundary.

B21t—22 to 32 inches, grayish-brown (10YR 5/2) clay loam; many, fine, distinct, strong-brown (7.5YR 5/6) mottles; moderate, medium, subangular blocky structure; thin discontinuous clay films; medium acid; clear, smooth boundary.

B22t—32 to 47 inches, grayish-brown (10YR 5/2) clay loam; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; thin continuous clay films; medium acid; gradual, smooth boundary.

B3t—47 to 61 inches, dark yellowish-brown (10YR 4/4) light clay loam; common, medium, distinct, gray (10YR 6/1) mottles; moderate, medium, subangular blocky structure; firm; thin discontinuous clay films; mildly alkaline.

The A11 horizon is very dark brown, black, or very dark gray and ranges from 9 to 15 inches in thickness. The B horizon is very dark grayish brown, dark grayish brown, or grayish brown and ranges from 35 to 50 inches in thickness.

Vigar soils are near Lindley and Arbela soils on the landscape. They have a thicker, darker colored A horizon than Lindley soils. They lack an A2 horizon, which is characteristic of Arbela soils.

In this survey area, Vigar soils are outside the defined range for the Vigar series, because they have color values greater than 4 and mottles in the layer directly below the darker colored surface layer.

VgB—Vigar loam, 2 to 5 percent slopes. This soil is in concave areas at the base of upland slopes and at a slightly higher elevation than flood plains. It occurs in irregularly shaped areas about 5 to 25 acres in size. The areas parallel the base of the upland slopes.

Included with this soil in mapping are small areas of Vigar soil that have slopes greater than 5 percent. These areas make up about 15 percent of the mapped acreage. Also included are areas of Vigar soil that have slopes of less than 2 percent.

Runoff is medium. Erosion is a moderate hazard. Constructing diversions at the base of the upland slope helps to protect the soil from excess water.

This soil is used mainly for corn and soybeans. Some small, narrow areas are used for hay. Capability unit IIe-2.

Wabash Series

The Wabash series consists of deep, very poorly drained, nearly level soils on bottom lands. These soils formed in clayey material. The native vegetation was tall prairie grasses.

In a representative profile the surface layer is black silty clay about 10 inches thick. The subsoil is about 64 inches thick. It is very dark gray, very firm silty clay in the upper part and dark-gray, very firm silty clay in the lower part.

Wabash soils have very slow permeability. Available water capacity is moderate. Organic-matter content is moderate, and natural fertility is high.

These soils are used for row crops. Wetness is the main limitation.

Representative profile of Wabash silty clay, in a cultivated field, 825 feet east and 1,700 feet north of the southwest corner of sec. 10, T. 62 N., R. 12 W., in Knox County:

Ap—0 to 10 inches, black (10YR 2/1) silty clay; moderate, fine, subangular blocky structure; firm; few fine roots; very strongly acid; gradual, smooth boundary.

B1g—10 to 23 inches, very dark gray (N 3/0) silty clay; few, fine, distinct, olive-brown (2.5Y 4/4) mottles; moderate, fine, subangular blocky structure; very firm; few fine roots; medium acid; gradual, smooth boundary.

B2g—23 to 37 inches, very dark gray (N 3/0) silty clay; moderate and weak, subangular blocky structure; very firm; very few fine roots; neutral; clear, smooth boundary.

B3g—37 to 74 inches, dark-gray (N 4/0) silty clay; few, fine, distinct, dark-brown (10YR 3/3) mottles; weak, fine, subangular blocky structure; very firm; few concretions of oxides; some very fine sand at a depth of 68 inches; neutral.

The Ap horizon is black, very dark gray, or dark grayish brown and ranges from 10 to 15 inches in thickness. The B horizon is very dark gray, dark gray, and dark grayish brown.

Wabash soils are near Chequest and Arbela soils on the landscape. They have more clay throughout the profile than Chequest soils. They lack an A2 horizon, which is characteristic of Arbela soils.

Wa—Wabash silty clay. This level and nearly level soil is on flood plains, about halfway between stream channels and uplands. The areas are generally slightly depressional. This soil occurs in uniformly shaped areas about 10 to 100 acres in size.

Included with this soil in mapping are small areas of Chequest soils. These areas make up about 10 percent of the mapped acreage.

Runoff is slow. Wetness is a severe limitation. This soil is subject to overflow. Large cracks form in dry seasons. Constructing drainage ditches and land grading and smoothing help to remove excess water.

This soil is used for corn, soybeans, and wheat. Plowing in fall is more practical than in spring, because wetness delays tillage in spring. Capability unit IIIw-14.

Use and Management of the Soils

This section discusses the use of soils for cultivated crops and pasture and provides information about the present use of the soils, and the limitations and applicable practices related to these uses. It explains the capability classification system and gives general suggestions for the management of soils in each capability unit. Estimated yields for specified crops are also given. This section also provides information on suitability of the soils for woodland, wildlife habitat, recreation, and engineering purposes.

Specific management practices for individual soils are not suggested in this section. Detailed information on use and management is available from the local district conservationists of the Soil Conservation Service or from the Cooperative Extension Services of Knox, Monroe, and Shelby Counties.

Cultivated Crops and Pasture

About 75 percent of the acreage of Knox, Monroe, and Shelby Counties is cropland, 20 percent of which is used for pasture. Corn, soybeans, and hay are grown on about 65 percent of the cropland. The rest is idle or is used for farmsteads and lots.

The main considerations in managing soils for cropland are controlling water erosion; draining the soils; and maintaining organic-matter content, fertility, and soil structure.

Measures for controlling erosion include terracing, building diversions, farming on the contour, planting cover crops, strip cropping, using grassed waterways, using minimum tillage, and returning crop residue to the soils. Generally a combination of several practices is used.

Practices that help to maintain fertility include applying lime, chemical fertilizer, green manure crops, and barnyard manure, using a cropping system that includes cover crops, grasses, and legumes, and returning all crop residue to the soils. Controlling erosion also helps to maintain fertility.

Practices to improve pasture include clearing brush; using herbicides to control weeds and brush, applying lime and fertilizer; and reseeding adapted grasses or legumes and then managing the pasture for optimum production.

On the pages that follow, the system of capability grouping used by the Soil Conservation Service is discussed; the soils in each capability unit are described; and management practices suited to the soils in each unit are suggested.

Capability grouping

Capability grouping (*11*) shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitation when used for field crops, the risk of damage to the soils when they are so used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for forest trees or engineering.

In the capability system, the kinds of soil are grouped at three levels: the capability class, the subclass, and the unit. These levels are described in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife habitat, or water supply, or to esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is a hazard of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture or range, woodland, wildlife habitat, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other response to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-5 or IIIw-2. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass or kind of limitation as defined in the foregoing paragraph; and the Arabic numeral identifies the capability unit within each subclass.

Capability unit numbers generally are assigned locally but are a part of a statewide system. All of the units in the system are not represented by the soils of Knox, Monroe, and Shelby Counties; therefore, the capability unit numbers in this soil survey are not consecutive.

In the following pages the capability units in Knox, Monroe, and Shelby Counties are described, and suggestions for the use and management of the soils are given.

CAPABILITY UNIT I-1

Fatima silt loam is the only soil in this unit. This soil is nearly level and moderately well drained. The surface layer and subsoil are silt loam. Available water capacity is very high, and natural fertility is high. Permeability is moderate.

This soil is well suited to cultivation. It is easily tilled, and good tilth is easily maintained. Protection from flooding is needed to maintain optimum production in some low-lying areas.

This soil is used mainly for corn and other row crops. Some areas are used for small grain and hay. This soil is also suited to pasture, woodland, and other less intensive uses.

CAPABILITY UNIT IIe-2

Vigar loam, 2 to 5 percent slopes, is the only soil in this unit. This soil is moderately well drained. The subsoil is clay loam. Available water capacity and natural fertility are high. Permeability is moderately slow.

Runoff received from soils directly upslope increases the hazard of erosion. Constructing a diversion terrace at the base of upland slopes helps to control runoff. This soil is easily tilled, and good tilth is easily maintained.

This soil is used mainly for corn and other row crops, small grain, and hay. It is also suited to pasture, woodland, and other less intensive uses.

CAPABILITY UNIT IIe-5

This unit consists of gently sloping, somewhat poorly drained soils. These soils have a surface layer of silt loam and a subsoil of silty clay. Available water capacity is high, and natural fertility is medium or high. Permeability is slow or very slow.

Runoff received following heavy rains increases the hazard of erosion. Using minimum tillage, constructing terraces, and farming on the contour help to control erosion. These soils are easily tilled. Good tilth can be maintained if the soils are tilled under favorable moisture conditions to prevent puddling and if a high content of organic matter is maintained.

These soils are used mainly for corn, soybeans, and other row crops, and for small grain. They are also suited to hay, pasture, woodland, and other less intensive uses.

CAPABILITY UNIT IIw-1

This unit consists of nearly level, somewhat poorly drained and poorly drained soils. These soils have a surface layer of silt loam or silty clay loam and a subsoil of silt loam and silty clay loam. Available water capacity is high and very high, and natural fertility is high. Permeability is moderate, moderately slow, or slow.

Wetness is a limitation. It is caused by flooding, a high water table, or slow internal drainage. Good tilth can be maintained if surface drainage is used to control wetness and if the soils are not tilled when wet.

These soils are used mainly for corn, soybeans, and small grain. Some areas are used for hay, pasture, trees, and other less intensive uses.

CAPABILITY UNIT IIw-2

This unit consists of nearly level, poorly drained soils. These soils have a surface layer of silt loam or silty clay loam and a subsoil of silty clay or silty clay loam. Available water capacity and natural fertility are high. Permeability is moderately slow, slow, or very slow. These soils dry out slowly in spring and after heavy rains.

Wetness is a limitation. It is caused mainly by slow permeability and slow surface drainage. Flooding also increases wetness. Good tilth can be maintained if the soils are tilled under favorable moisture conditions. Using surface drainage helps to prevent ponding.

These soils are used mainly for corn and other row crops and for small grain (fig. 5). They are also suited to hay, pasture, woodland, and other less intensive uses.

CAPABILITY UNIT IIIe-5

This unit consists of gently sloping and moderately sloping, moderately well drained, somewhat poorly drained, and poorly drained soils. These soils have a surface layer of silt loam or loam and a subsoil of silty clay or clay. Available water capacity is moderate or high, and natural fertility ranges from low to high. Permeability is slow or very slow.

Runoff received following heavy rains increases the hazard of erosion. Erosion-control practices are needed if the soils are used for crops. Except for the severely eroded areas, these soils are easily tilled. Good tilth can be maintained if the soils are tilled under favorable moisture conditions to prevent puddling and if a high content of organic matter is maintained.

These soils are used mainly for corn and other row crops, small grain, and hay. They are also suited to pasture and other less intensive uses.

CAPABILITY UNIT IIIw-2

This unit consists of nearly level, poorly drained soils. These soils have a surface layer of silt loam and a subsoil of silty clay or silty clay loam. Available water capacity is high, and natural fertility is low. Permeability is slow or very slow. These soils dry out slowly in spring and after heavy rains.

Wetness is a limitation. It is caused by slow permeability, slow surface drainage, and a high water table. Some of the soils are subject to periodic flooding. Constructing surface drainage ditches and levees helps to control excess water. Good tilth is difficult to maintain because of low organic-matter content.

These soils are used for row crops, small grain, and hay. Because of their low fertility, they are better suited to small grain, hay, or pasture than to row crops. They are also suited to woodland, wildlife habitat, and other less intensive uses.

CAPABILITY UNIT IIIw-14

Wabash silty clay is the only soil in this unit. This soil is nearly level and very poorly drained. The subsoil is silty clay. Available water capacity is moderate, and natural fertility is high. Permeability is very slow.

Wetness is a severe limitation. It is caused mainly by very slow permeability and periodic flooding. Constructing surface drainage ditches and levees helps to remove the excess water. When this soil is wet, it is plastic in consistence, and it becomes hard and cracks when dry. Good tilth is difficult to maintain, because the soil can be tilled only within a narrow range of moisture conditions.

This soil is used mainly for soybeans, corn, and small grain. Areas that cannot be artificially drained

Figure 5.—**A good stand of corn on Putnam silt loam.**

are suited to pasture or to habitat for wetland wildlife.

CAPABILITY UNIT IIIs–1

Kickapoo fine sandy loam is the only soil in this unit. This soil is nearly level and moderately well drained. The subsoil is sandy loam. Available water capacity is high, and natural fertility is low. Permeability is moderately rapid.

This soil is subject to flooding. Crops are likely to be damaged if it is used for row crops or small grain. Levees are needed to protect this soil from flooding. This soil is easily tilled, because it has a surface layer of fine sandy loam.

This soil is used mainly for small grain, pasture, and woodland. It is suited to corn, alfalfa, and other row crops if rainfall is adequate or if it is irrigated, but it is better suited to woodland or to pasture crops that can resist drought.

CAPABILITY UNIT IVe–1

Gara loam, 9 to 14 percent slopes, is the only soil in this unit. This soil is moderately well drained. The surface layer is loam, and the subsoil is clay loam. Available water capacity is high, and natural fertility is medium. Permeability is moderately slow.

Runoff received following heavy rains increases the hazard of erosion. Constructing terraces helps to control erosion. This soil is easily tilled, but it is generally dissected by so many small drainage ditches that use of large machinery to cultivate row crops is not practical.

This soil is used mainly for small grain, hay, and pasture. Some areas are used for row crops, but they are better suited to hay, pasture, and other less intensive uses.

CAPABILITY UNIT IVe–5

This unit consists of strongly sloping, somewhat poorly drained and moderately well drained soils. These soils have a surface layer of loam or silt loam and a subsoil of silty clay, clay loam, or clay. Available water capacity is moderate, and natural fertility is low to high. Permeability is slow.

Runoff received following heavy rains increases the hazard of erosion. Erosion-control measures such as terraces are needed if the soils are used for crops. These soils are easily tilled, but they are generally dissected by so many small drainage ditches that use of large machinery to cultivate row crops is not practical.

These soils are used mainly for small grain, hay, and pasture (fig. 6). Some areas are used for row crops, but they are better suited to hay, pasture, and other less intensive uses.

CAPABILITY UNIT IVe–7

Gosport silty clay loam, 5 to 9 percent slopes, is the only soil in this unit. This soil is moderately well drained. The surface layer is silty clay loam, and the subsoil is silty clay or clay. Available water capacity is moderate, and natural fertility is low. Permeability is very slow.

A few areas of this soil are tilled, but the areas are

Figure 6.—**Grasses and legumes on Armstrong loam, 9 to 14 percent slopes, eroded.**

generally dissected by so many small drainage ditches that use of large machinery to cultivate row crops is not practical.

This soil is used mainly for small grain, hay, and pasture. Some areas are used for row crops, but they are better suited to pasture, woodland, and other less intensive uses.

CAPABILITY UNIT VIe-1

Gara loam, 14 to 20 percent slopes, is the only soil in this unit. This soil is moderately well drained. The surface layer is loam, and the subsoil is clay loam. Available water capacity is high, and natural fertility is medium. Permeability is moderately slow.

Runoff is rapid, and erosion is a hazard. Minimum tillage should be used when reseeding.

This soil is used mainly for hay and pasture. Some areas are used for row crops and small grain, but they are better suited to pasture and other less intensive uses.

CAPABILITY UNIT VIe-4

Lindley loam, 14 to 20 percent slopes, is the only soil in this unit. This soil is well drained. The surface layer is loam, and the subsoil is clay loam. Available water capacity is high, and natural fertility is low. Permeability is moderately slow.

Runoff is rapid. Minimum tillage should be used when reseeding pasture.

This soil is used mainly for pasture and woodland (fig. 7). Some areas are used for small grain and hay, but they are better suited to pasture, woodland, and other less intensive uses.

CAPABILITY UNIT VIe-7

Gosport silty clay loam, 9 to 14 percent slopes, is the only soil in this unit. This soil is moderately well drained. The surface layer is silty clay loam, and the subsoil is silty clay or clay. Available water capacity is moderate, and natural fertility is low. Permeability is very slow.

Runoff is rapid on this soil, and erosion is a hazard. Use of mechanical means to control erosion is not practical, because of steepness of slopes. This soil should be tilled only to reestablish permanent pasture or hay.

This soil is used mainly for pasture and woodland. Some areas are used for hay and small grain, but they are better suited to pasture, woodland, and other less intensive uses.

CAPABILITY UNIT VIIe-4

Lindley loam, 20 to 30 percent slopes, is the only soil in this unit. This soil is well drained. The surface layer is loam, and the subsoil is clay loam. Available water capacity is high, and natural fertility is low. Permeability is moderately slow.

Runoff is rapid, and erosion is a hazard. Use of mechanical means to control erosion is not practical, because of steepness of slopes. This soil should be tilled only when reestablishing permanent pasture.

This soil is used mainly for trees and pasture. Small

Figure 7.—An area of Lindley loam, 14 to 20 percent slopes, used as woodland.

areas are used for hay but are better suited to pasture and other less intensive uses.

CAPABILITY UNIT VIIe-7

Gosport silty clay loam, 14 to 20 percent slopes, is the only soil in this unit. This soil is moderately well drained. The surface layer is silty clay loam, and the subsoil is silty clay or clay. Available water capacity is moderate, and natural fertility is low. Permeability is very slow.

Runoff is rapid, and erosion is a hazard. Use of mechanical means to control erosion is not practical, because of steepness of slopes. Tillage should be used only when reestablishing permanent pasture or hay crops.

This soil is used mainly for pasture and woodland. Some small areas are used for hay, but they are better suited to pasture, woodland, and other less intensive uses.

CAPABILITY UNIT VIIs-9

Goss cherty silt loam, 20 to 30 percent slopes, is the only soil in this unit. This soil is well drained. The surface layer is cherty silt loam, and the subsoil is cherty silty clay. Available water capacity and natural fertility are low. Permeability is moderate.

Erosion is a hazard. If this soil is used for pasture, it is difficult to maintain an adequate cover of vegetation to help control erosion.

This soil is used mainly for pasture and woodland. Small areas are used for hay, but they are better suited to woodland and other less intensive uses.

CAPABILITY UNIT VIIs-10

Only Rock land is in this unit. Stones are on the surface. Available water capacity is very low, and natural fertility is low. Permeability is moderate to slow.

Maintaining adequate vegetation is difficult because of rock outcrops and stones on the surface. If this land type is used for pasture, seeding and controlling erosion are difficult.

This land type is used mainly for woodland. Small areas are used for timbered pasture, but they are better suited to woodland and other less intensive uses.

Predicted yields

For each mapping unit in Knox, Monroe, and Shelby Counties, table 2 lists the predicted average yields per acre of principal crops under two levels of management. The estimates are based on the observations of the soil scientists who made the survey, as well as information obtained from local farmers, professional agronomists, public and private agencies, demonstration plots, and research data.

Management practices, weather conditions, plant diseases, and insect infestations vary from year to year and from place to place. Differences in any of these factors, especially droughts during the summer months, cause great fluctuations in crop yields. In places crop damage can also be heavy as a result of wind, hail, torrential downpours of rain, or flooding.

Columns A show the predicted yields that can be expected over a period of years under the system of management practices used by most of the farmers growing

TABLE 2.—*Predicted average yields per acre of principal crops under two levels of management*

[Yields in columns A are to be expected under ordinary management and those in columns B under improved management. Absence of yield figures indicates that the crop is not generally grown on the soil]

Soil	Corn		Grain sorghum		Wheat		Soybeans		Alfalfa-orchard-grass		Tall fescue	
	A	B	A	B	A	B	A	B	A	B	A	B
	Bu	*Bu*	*Bu*	*Bu*	*Bu*	*Bu*	*Bu*	*Bu*	*Tons*	*Tons*	*AUM* [1]	*AUM* [1]
Arbela silt loam	70	108	63	94	30	45	27	41	3.2	4.8	6.4	9.6
Armstrong loam, 5 to 9 percent slopes	46	69	40	58	18	28	17	25	2.0	3.1	4.2	6.3
Armstrong loam, 9 to 14 percent slopes, eroded	40	60	34	50	15	25	15	20	1.8	2.7	3.6	5.4
Auxvasse silt loam	46	69	40	58	18	28	17	25	2.0	3.1	4.2	6.3
Blackoar silt loam	68	102	58	88	30	45	25	38	3.0	4.5	6.0	9.0
Calwoods silt loam, 2 to 5 percent slopes	52	78	44	66	20	35	20	30	2.3	3.5	5.0	7.0
Chariton silt loam	46	69	40	58	18	28	17	25	2.0	3.1	4.2	6.3
Chequest silty clay loam	57	86	48	72	23	35	21	32	2.5	3.8	5.0	7.4
Fatima silt loam	68	102	58	88	28	42	25	38	3.0	4.5	6.0	9.0
Gara loam, 9 to 14 percent slopes	52	78	44	66	23	35	20	30	2.3	3.5	5.0	7.0
Gara loam, 14 to 20 percent slopes									2.0	3.1	4.0	6.0
Gifford silt loam, 2 to 5 percent slopes	56	84	50	75	25	35	22	33	2.5	3.7	5.0	7.4
Gifford silt loam, 5 to 9 percent slopes	48	72	40	60	20	30	15	26	2.2	3.3	4.4	6.6
Gorin silt loam, 5 to 9 percent slopes, eroded	36	54	30	44	14	22	15	20	1.6	2.5	3.0	5.0
Gosport silty clay loam, 5 to 9 percent slopes	37	55	31	45	15	23	16	21	1.7	2.6	3.1	5.1
Gosport silty clay loam, 9 to 14 percent slopes									1.6	2.3	3.0	4.6
Gosport silty clay loam, 14 to 20 percent slopes									1.3	2.0	2.6	4.0
Goss cherty silt loam, 20 to 30 percent slopes									.8	1.4	1.8	2.8
Keswick loam, 5 to 9 percent slopes, eroded	38	57	30	46	15	24	15	20	1.6	2.5	3.4	5.2
Keswick loam, 9 to 14 percent slopes, eroded	32	48	25	39	14	20	10	15	1.6	2.3	3.0	4.6
Kickapoo fine sandy loam	45	67	35	55	18	27	16	24	2.0	3.0	4.0	6.0
Kilwinning silt loam, 2 to 5 percent slopes	53	80	46	68	22	33	20	30	2.5	3.5	4.3	7.0
Leonard silt loam, 5 to 9 percent slopes, eroded	43	65	37	55	18	27	16	24	2.0	3.0	4.0	6.0
Leonard silt loam, 9 to 14 percent slopes, eroded	37	55	30	45	15	25	14	20	1.6	2.5	3.0	5.0
Lindley loam, 14 to 20 percent slopes									1.8	2.7	3.6	5.4
Lindley loam, 20 to 30 percent slopes									1.7	2.6	3.5	5.2
Marion silt loam, 0 to 2 percent slopes	43	65	36	55	15	25	15	25	2.0	3.0	4.0	6.0
Marion silt loam, 2 to 5 percent slopes	40	60	32	50	15	25	15	21	1.8	2.7	3.6	5.4
Mexico silt loam, 2 to 5 percent slopes	52	78	44	66	22	33	20	30	2.4	3.5	4.6	7.0
Mexico silt loam, 2 to 5 percent slopes, eroded	45	67	37	56	18	27	16	24	2.0	3.0	4.0	6.0
Moniteau silt loam	40	60	32	50	16	25	15	20	1.8	2.7	3.6	5.4
Piopolis silty clay loam	64	96	55	83	25	40	25	36	2.9	4.3	5.7	8.6
Putnam silt loam	45	68	38	57	20	30	16	25	2.0	3.0	4.0	6.0
Rock land											1.0	1.6
Vigar loam, 2 to 5 percent slopes	70	108	63	94	30	45	27	41	3.2	4.8	6.4	9.6
Wabash silty clay	52	78	44	66	23	35	20	30	2.3	3.5	5.0	7.0

[1] AUM stands for animal-unit-month, a term used to express the carrying capacity of pasture. It is the number of animal units per acre multiplied by the number of months the pasture is grazed during a season.

Figure 8.—White oak trees on Lindley loam, 14 to 20 percent slopes.

the crop. Crops are generally planted according to field boundaries. Only a small amount of the acreage is terraced, and not all the fields are cultivated on the contour. Wet areas are drained, but better system of drainage is often needed. Lime and fertilizer are applied regularly, but only about half the amount shown to be needed by soil tests is applied. Some farm operations are not as timely as is desirable.

Predictions in columns B are based on a combination of improved management practices used by some farmers in the counties. A systematic cropping plan, consistent with the capability of the soils, is followed. Sloping upland areas are terraced, and most slopes of more than 2 percent are cultivated on the contour. Adequate drainage is installed as needed. Adapted high-yielding varities of crops are planted. Lime and fertilizer are applied regularly, according to soil tests, for optimum yields. Considerable attention is given to new methods of weed control and management of crop residue. All farm operations are timely.

The yield predictions in table 2 are approximate figures and are intended to serve only as guides. Many users will find the comparison of yields of various soils to be of more value than the actual predictions. These relationships are likely to remain constant over a period of years.

Woodland [2]

In 1967 about 152,000 acres, or about 15 percent of the acreage of Knox, Monroe, and Shelby Counties, remained in woodland. Wooded tracts (fig. 8) are relatively small and about two-thirds of the acreage is used for grazing.

Major soils on which timber is grown are Blackoar, Gorin, Goss, Keswick, Lindley, and Marion. Only these soils are rated in this section.

These soils are placed in woodland suitability groups (*3, 4*) to assist owners in planning the use of their soils for wood crops (table 3). Each group is made up of soils that are suited to the same kinds of trees, that need approximately the same kind of management when the vegetation on them is similar, and that have about the same potential productivity.

Each woodland group is identified by a three-part symbol, such as 3w4, 4c5, or 4f6. The first part of the symbol, a number, indicates the relative productivity of the soils in the group: 1 is very high; 2, high; 3, moderately high; 4, moderate; and 5, low. These ratings are based on site index. Site index is the height in feet that the dominant trees of a given species will reach

[2] FRANCIS T. HOLT, forester, Soil Conservation Service, helped to prepare this section.

TABLE 3.—*Woodland suitability of selected soils, potential productivity, hazards and limitations to management, and suitable species*

Woodland suitability groups, soil series, and map symbols	Potential productivity			Management hazards or limitations					Suitable species—	
	Species	Site index	Average growth per acre [1]	Seedling mortality	Erosion hazard	Windthrow hazard	Plant competition	Equipment restrictions	In existing stands	For planting
			Board feet							
3w4: Deep, nearly level, poorly drained soils on flood plains. The surface layer is silt loam. Permeability is moderate. Blackoar: Bk.	Pin oak	85	370	Moderate	Slight	Moderate	Severe	Severe	Pin oak, white ash.	Pin oak, eastern cottonwood, sycamore, sweetgum.
4c5: Deep, moderately sloping and strongly sloping, somewhat poorly drained or moderately well drained soils on convex ridgetops and side slopes. The surface layer is silt loam or loam. Permeability is slow. Gorin: GoC2; Keswick: KeC2, KeD2.	Upland oaks.	58	190	Slight	Slight	Slight	Slight	Slight	Upland oaks.	Green ash, yellow-poplar, black walnut.[2]
4f6: Deep, steep, well-drained soils on side slopes. The surface layer is cherty silt loam. Permeability is moderate. Goss: GsF.	Upland oaks.	51	130	Moderate	Slight	Slight	Slight	Severe	Upland oaks.	Green ash, yellow-poplar, sweetgum.
4r6: Deep, moderately steep to steep, well-drained soils on side slopes. The surface layer is loam. Permeability is moderately slow. Lindley: LdE, LdF.	Upland oaks.	60	190	Moderate	Moderate	Slight	Slight	Moderate	Upland oaks.	Green ash, yellow-poplar, black walnut.[2]
5w6: Deep, nearly level, poorly drained soils in flat upland areas. The surface layer is silt loam. Permeability is very slow. Marion: MaA.	Upland oaks.	48	130	Moderate	Slight	Moderate	Severe	Severe	Upland oaks.	Green ash.

[1] Based on Doyle Rule.

[2] Confine black walnut to cool slopes, coves, benches, and bases of slopes.

in a natural, unmanaged stand in a stated number of years. In table 3 all site index data are based on height at 50 years of either pin oak or upland oaks. The species and site index information is based on actual field measurements for the indicated mapping unit.

The second part of the symbol identifying a woodland group is a small letter indicating an important soil property that imposes slight to severe hazards or limitations in managing the soils of the group for wood crops. A letter *f* indicates that soils have limitations because large amounts of coarse fragments are in the profile; *w* indicates that water in or on the soil, either seasonally or year round, is the chief limitation; *r* indicates that steepness of slope will affect timber management; and *c* shows that the main limitation is the kind or amount of clay in the upper part of the soil.

The third part of the symbol indicates the degree of hazard or limitation and general suitability of the soils for certain kinds of trees.

The numeral *1* indicates soils that have no limitations or only slight limitations for the production of coniferous species.

The numeral *2* indicates soils that have one or more moderate limitations for the production of coniferous species.

The numeral *3* indicates soils that have one or more severe limitations for the production of coniferous species.

The numeral *4* indicates soils that have no limitations or only slight limitations for the production of deciduous species.

The numeral *5* indicates soils that have one or more moderate limitations for the production of deciduous species.

The numeral *6* indicates soils that have one or more severe limitations for the production of deciduous species.

The numeral *7* indicates soils that have no limitations or only slight limitations for the production of either coniferous or deciduous species.

The numeral *8* indicates soils that have one or more moderate limitations for the production of either coniferous or deciduous species.

The numeral *9* indicates soils that have one or more severe limitations for the production of either coniferous or deciduous species.

The hazards or limitations that affect management of soils for woodland are seedling mortality, erosion hazard, windthrow hazard, plant competition, and equipment restrictions. These limitations are rated for each group in table 3 and are briefly described in the following paragraphs.

Seedling mortality refers to the expected percent of loss of naturally occurring or planted seedlings, as influenced by soil texture, depth, drainage, flooding, height of the water table, and degree of erosion. Mortality is *slight* if the expected loss of seedlings is less than 25 percent; *moderate* if losses are between 25 and 50 percent; and *severe* if losses are more than 50 percent.

Erosion hazard refers to the degree of potential erosion that is likely to occur where normal practices are used in managing and harvesting trees. It is *slight* if erosion control is not an important concern; it is *moderate* if some attention must be given to reducing loss of soil by erosion. It is *severe* if intensive and generally expensive measures must be taken to control erosion.

Windthrow hazard indicates the relative danger of trees being blown over by high winds of normal severity, excluding tornadoes. The hazard is *slight* if windthrow is no special concern, and it is *moderate* if roots hold the trees firmly except when the soil is excessively wet or when the wind is strongest.

Plant competition refers to invasion or growth by other plants. The rating is *slight* if competition from other plants does not prevent trees from restocking naturally. It is *moderate* if plant competition occurs but generally does not prevent an adequate stand of trees from becoming established. It is *severe* if plant competition prevents trees from restocking naturally.

The ratings for *equipment restrictions* are based on the degree to which soil characteristics and topographic features restrict the use of equipment normally employed in tending a crop of trees. The limitation is *slight* if there is little or no restriction on the type of equipment that can be used or the time of year that it can be used. It is *moderate* if the use of equipment is limited in some seasons or if modified equipment or methods of harvesting are needed. It is *severe* if special equipment is needed or if the use of equipment is severely restricted by one or more unfavorable soil characteristics, such as poor natural drainage, slope, number or size of stones, and soil texture.

Wildlife

This section provides information that is useful in planning, developing, and managing soils to provide habitat for wildlife. Proper management of soil, water, and plants to produce suitable habitat is the most effective way to maintain and improve wildlife populations. Knox, Monroe, and Shelby Counties support a number of species of wildlife.

Turkeys have been stocked in all three counties. The initial stockings have grown to the extent that hunting of turkeys was permitted in Monroe County in 1970 and in Knox and Shelby Counties in 1973.

As late as 1940, each of the three counties had a sizable population of prairie chickens. Today only a small number remain in southeast Monroe County.

Deer populations and extent of habitat are good in the counties. In recent years hunters have taken between 300 and 400 deer annually in each county.

The population of the ring-necked pheasant in Shelby and Monroe Counties has gradually increased over the past 25 years, but in Knox County it has remained very low. Hybrid pheasants were stocked in Shelby County near Clarence from 1962 to 1967. These birds, however, have been gradually declining in number since stocking.

Habitat for cottontail rabbits and squirrels is very good in the survey area. Fox squirrels are more common than gray squirrels. The population of rabbits has been declining statewide since 1968 but is now increasing.

High-value habitat for bobwhite quail is scattered throughout the three counties and provides significant numbers of birds for hunters.

Grassland, cropland, and woodland provide many kinds of habitats for a varied population of songbirds and other nongame birds.

Streams in the area support such warm-water fish as carp, channel catfish, black and yellow bullheads, largemouth bass, bluegill, green sunfish and various other sunfish, shiners, darters, minnows, and suckers.

Principal streams in the survey area are South Fabius River, North River, Black Creek, North Fork, Middle Fork, Elk Fork, and Salt River. When Clarence Cannon Reservoir is completed, it will provide many thousands of acres of lake-type fishery habitat in eastern Monroe County. The reservoir will also provide resting areas for waterfowl during spring and fall migrations.

Elements of wildlife habitat and kinds of wildlife

The soils of Knox, Monroe, and Shelby Counties are rated in table 4 according to their suitability for development of wildlife habitat. In rating the soils the following soil properties and characteristics were given major emphasis: depth to which roots and water can penetrate, surface texture, natural drainage, surface stoniness, hazard of flooding, slope, permeability, and available water capacity. Factors that were not considered were existing vegetation; present land use; size, shape, and location of area; and the movement of wildlife from place to place.

Information related to the use of the soils for wildlife habitat can also be found in other sections of this survey. For example, the management practices suggested for cropland and pasture in the section "Cultivated Crops and Pasture" also apply to plants grown for food and cover for wildlife. Table 3 lists trees suited to various soils. It is well to keep in mind, however, that trees undesirable as commercial timber are not necessarily undesirable as elements of wildlife habitat. The section "Engineering Uses of the Soils" contains information on water control and pond construction that can be useful in creating wildlife habitat.

The information provided in table 4 is helpful in selecting sites and planning and developing wildlife habitat. It indicates limitations affecting the use of the soils as habitat for openland, woodland, and wetland wildlife.

A rating of *good* indicates that wildlife habitat can be created, improved, or maintained with minimum difficulty. Few or no soil limitations impede management of wildlife habitat, and satisfactory results can be expected. A rating of *fair* indicates that wildlife habitat generally can be created, improved, or maintained, but moderate soil limitations affect management. Moderately intense management and fairly frequent attention are required to assure satisfactory results. A rating of *poor* indicates that wildlife habitat generally can be created, improved, or maintained, but soil limitations are severe. Management is difficult and expensive, or it requires intensive effort. A rating of *very poor* indicates that the soil cannot be practically used for wildlife habitat.

Most managed wildlife habitat is created, improved, or maintained by: (1) planting suitable vegetation; (2) manipulating existing vegetation; (3) inducing natural establishment of desired plants; or (4) combinations of such measures. The eight elements of wildlife habitat selected for rating are discussed in the following paragraphs.

Grain and seed crops are grain- or seed-producing annuals, such as corn, soybeans, wheat, oats, millet, and sorghum, planted to produce food for wildlife.

Grasses and legumes are domestic perennial grasses and herbaceous legumes, such as fescue, brome, timothy, redtop, orchardgrass, reed canarygrass, clover, trefoil, alfalfa, and lespedeza, planted to provide food and cover for wildlife.

Wild herbaceous upland plants are native or introduced perennial grasses and weeds that provide food and cover, principally for upland wildlife, and that are established mainly through natural processes. They include big bluestem, little bluestem, some of the panicums and other native grasses, partridge peas, beggarticks, various native lespedezas, and other native herbs.

Hardwood woodland plants are nonconiferous trees, shrubs, and woody vines that produce fruits, nuts, buds, catkins, twigs, or foliage used extensively as food by wildlife. They are commonly established through natural processes but are sometimes planted. They include dogwood, sumac, sassafras, persimmon, hazelnut, shrub lespedezas, wildcherry, autumn-olive, various oaks and hickory, grape, plum, blackberry, blackhaw, honeysuckle, and roses.

Coniferous woodland plants are cone-bearing trees and shrubs that are important to wildlife primarily as cover, but they also furnish food in the form of browse, seeds, or fruitlike cones. Examples are Virginia pine, white pine, shortleaf pine, Scotch pine, red pine, and redcedar. The rating is based on growth rate limitations that produce dense, low foliage and delayed canopy closure, rather than on production of timber.

Wetland food and cover plants are annual and perennial wild herbaceous plants that grow in moist to wet sites, exclusive of floating or submerged aquatics. These plants produce food or cover used mainly by wetland forms of wildlife. They include smartweed, bulrush, barnyardgrass, duckweed, pondweed, pickerelweed, cattail, and various sedges.

Shallow-water developments are impoundments or excavations for control of water, generally not more than 5 feet in depth. Examples are low dikes and levees; shallow dugouts, such as borrow pits along highways and levees; level ditches; and devices for water-level control in marshy streams or channels.

As shown in table 4, three main classes of wildlife are in Knox, Monroe, and Shelby Counties. These classes are defined as follows:

Openland wildlife consists of birds and mammals that normally make their homes on cropland, pastures, lawns, and areas overgrown by grasses, herbs, and shrubby plants. Examples of this kind of wildlife are bobwhite quail, prairie chicken, meadowlark, field sparrow, redwing blackbird, cottontail rabbit, jackrabbit, red fox, and woodchuck.

Woodland wildlife consists of birds and mammals that generally make their homes in wooded areas among hardwood trees and shrubs, coniferous trees and shrubs, or mixtures of such plants. Examples are thrush, vireo, scarlet tanager, turkey, squirrel, gray fox, deer, and raccoon.

Wetland wildlife consists of birds and mammals that generally make their homes in wet areas, such as ponds, marshes, and swamps. Examples are duck, geese, heron, mink, muskrat, and raccoon.

Recreation

Knowledge of soil characteristics is necessary in planning, developing, and maintaining areas used for recreation. In table 5 the soils of Knox, Monroe, and Shelby Counties are rated according to limitations that affect their suitability for camp areas, playgrounds, picnic areas, paths and trails, and golf fairways.

In table 5 the soils are rated as having *slight, moderate,* or *severe* limitations for the specified recreational uses. Moderate or severe limitations include such characteristics as wetness, susceptibility to flooding, permeability, slope, surface texture, and presence of coarse fragments on the surface. For all of these ratings, it is assumed that a good cover of vegetation can be established and maintained. A limitation of *slight* means that soil properties are generally favorable, and limitations are so minor that they can be easily overcome. A *moderate* limitation can be overcome or modified by planning, design, or special maintenance. A *severe* limitation means that costly soil reclamation, special design, intense maintenance, or a combination of these is required to overcome the limitation.

Camp areas are used intensively for tents and small camp trailers and the activities of outdoor living. Little preparation of the site is required other than shaping and leveling for tent and parking areas. Camp areas are subject to heavy foot traffic and limited vehicular traffic. Suitable soils are gently sloping, and have good drainage, a surface free of rocks and coarse fragments, freedom from flooding during periods of heavy use, and a surface that is firm after rains but not dusty when dry.

Playgrounds are used intensively for baseball, football, badminton, and similar organized games. Soils suitable for this use need to withstand intensive foot traffic. They should have a nearly level surface free of coarse fragments and rock outcrops, good drainage, freedom from flooding during periods of heavy use, and a surface that is firm after rains but not dusty when dry. If grading and leveling are required, depth to rock is important.

Picnic areas are attractive natural or landscaped tracts used mainly for preparing meals and eating outdoors. These areas are subject to heavy foot traffic. Most vehicular traffic, however, is confined to access roads. Suitable soils have a surface that is firm when wet but not dusty when dry, freedom from flooding during the season of use, and are not so sloping or stony as to greatly increase the cost of leveling sites or building access roads.

Paths and trails are used for local and cross-country travel by foot or on horseback. Design and layout should require little or no cutting and filling. Suitable soils are at least moderately well drained, are firm when wet but not dusty when dry, are not flooded more than once during the season of use, have slopes of less than 15 percent, and have few or no rocks or stones on the surface.

Golf fairways include the vegetated area between greens. Such soil properties as steepness, susceptibility to flooding, texture, and wetness are important because they affect establishment and maintenance of plant cover.

Engineering Uses of the Soils [3]

This section provides information about soils used as structural material or as the foundation upon which structures are built. Among those who can benefit from this section are members of planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among the properties of soils highly important in engineering are permeability, strength, compaction characteristics, soil drainage condition, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to bedrock, and soil slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
4. Correlate performance of structures already built with properties of the kinds of soil on which they are built for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
5. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
6. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 6 and 7, which show, respectively, several estimated soil properties significant to engineering and interpretations of soils for various engineering uses.

This information, however, does not eliminate the need for onsite investigation at sites selected for engineering works, especially those that involve heavy loads or that require excavations to depths greater than those used in the tables, generally depths greater than 6 feet. Inspection of sites, especially small ones, is needed also because many delineated areas of a given mapping unit contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have a different meaning in soil science than in engineering. The Glossary at the back of this publication defines many of these terms as they are commonly used in soil science.

Engineering soil classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*6*), used by the Soil Conservation Service, Department of Defense, and others, and the AASHTO system (*1*),

[3] JOHN L. SQUIRES, area engineer, Soil Conservation Service, helped to prepare this section.

TABLE 4.—*Suitability of soils for elements*

Soil series and map symbols	Elements of wildlife habitat			
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woodland plants
Arbela: Ar	Fair: somewhat poorly drained; flooding.	Good	Good	Good
Armstrong:				
AtC	Fair: slope	Good	Good	Good
AtD2	Fair: slope	Good	Good	Good
Auxvasse: Au	Poor: poorly drained.	Fair: poorly drained	Fair: poorly drained	Fair: poorly drained
Blackoar: Bk	Good	Good	Good	Fair: poorly drained
Calwoods: CaB	Fair: somewhat poorly drained.	Good	Good	Good
Chariton: Ch	Poor: poorly drained	Fair: poorly drained	Fair: poorly drained	Fair: poorly drained
Chequest: Cm	Poor: poorly drained	Fair: poorly drained	Fair: poorly drained	Fair: poorly drained
Fatima: Fa	Good	Good	Good	Good
Gara:				
GaD	Fair: slope	Good	Good	Good
GaE	Poor: slope	Fair: slope	Good	Good
Gifford:				
GfB	Fair: somewhat poorly drained.	Good	Good	Good
GfC	Fair: somewhat poorly drained; slope.	Good	Good	Good
Gorin: GoC2	Fair: somewhat poorly drained; slope.	Good	Good	Good
Gosport:				
GpC	Fair: slope	Good	Good	Good
GpD	Fair: slope	Good	Good	Good
GpE	Poor: slope	Fair: slope	Good	Good
Goss: GsF	Poor: low available water capacity; slope.	Fair: low available water capacity; slope.	Fair: low available water capacity.	Fair: low available water capacity.
Keswick:				
KeC2	Fair: slope	Good	Good	Good
KeD2	Fair: slope	Good	Good	Good
Kickapoo: Kk	Good	Good	Good	Good

of wildlife habitat and kinds of wildlife

Elements of wildlife habitat—Continued			Kinds of wildlife		
Coniferous woodland plants	Wetland food and cover plants	Shallow-water developments	Openland	Woodland	Wetland
Good	Fair: somewhat poorly drained.	Fair: somewhat poorly drained; moderately slow permeability.	Good	Good	Fair.
Good	Poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Very poor: slope	Very poor: slope	Good	Good	Very poor.
Fair: poorly drained.	Good	Fair: slope	Fair	Fair	Fair.
Fair: poorly drained.	Good	Fair: moderate permeability.	Good	Fair	Fair.
Good	Fair: somewhat poorly drained.	Poor: slope	Good	Good	Poor.
Fair: poorly drained.	Good	Good	Fair	Fair	Good.
Fair: poorly drained.	Good	Good	Fair	Fair	Good.
Good	Poor: moderately well drained.	Poor: moderately well drained.	Good	Good	Poor.
Good	Very poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Very poor: slope	Very poor: slope	Fair	Good	Very poor.
Good	Poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Poor: moderately well drained; slope.	Very poor: slope	Good	Good	Very poor.
Good	Very poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Very poor: slope	Very poor: slope	Fair	Good	Very poor.
Fair: low available water capacity.	Very poor: slope	Very poor: slope	Fair	Fair	Very poor.
Good	Poor: moderately well drained; slope.	Very poor: slope	Good	Good	Very poor.
Good	Very poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Poor: moderately well drained.	Poor: moderately well drained; moderately rapid permeability.	Good	Good	Poor.

TABLE 4.—*Suitability of soils for elements*

Soil series and map symbols	Elements of wildlife habitat			
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woodland plants
Kilwinning: KlB	Fair: somewhat poorly drained.	Good	Good	Good
Leonard:				
LcC2	Fair: somewhat poorly drained; slope.	Good	Good	Good
LcD2	Fair: somewhat poorly drained; slope.	Good	Good	Good
Lindley:				
LdE	Poor: slope	Fair: slope	Good	Good
LdF	Very poor: slope	Fair: slope	Good	Good
Marion:				
MaA	Poor: poorly drained.	Fair: poorly drained	Fair: poorly drained	Fair: poorly drained
MaB	Poor: poorly drained.	Fair: poorly drained	Fair: poorly drained	Fair: poorly drained
Mexico:				
MeB	Fair: somewhat poorly drained.	Good	Good	Good
MeB2	Fair: somewhat poorly drained.	Good	Good	Good
Moniteau: Mo	Poor: poorly drained	Fair: poorly drained	Fair: poorly drained	Fair: poorly drained
Piopolis: Po	Poor: poorly drained; flooding.	Fair: poorly drained; flooding.	Fair: poorly drained; flooding.	Fair: poorly drained
Putnam: Pu	Poor: poorly drained	Fair: poorly drained	Fair: poorly drained	Fair: poorly drained
Rock land: Rk	Very poor: soil depth; slope.	Very poor: soil depth; slope.	Poor: soil depth	Poor: soil depth
Vigar: VgB	Good	Good	Good	Good
Wabash: Wa	Very poor: very poorly drained.	Poor: very poorly drained.	Poor: very poorly drained.	Poor: very poorly drained.

adopted by the American Association of State Highway and Transportation Officials.

The Unified system is used to classify soils according to engineering uses for building material or for the support of structures other than highways. Soils are grouped into 15 classes according to particle-size distribution, plasticity index, liquid limit, and organic-matter content. Eight classes of coarse-grained soils are subdivided on the basis of gravel and sand content. These are identified as GW, GP, GM, GC, SW, SP, SM, and SC. Six classes of fine-grained soils are subdivided on the basis of the plasticity index. Nonplastic classes are ML, MH, OL, and OH; plastic classes are CL and CH. There is one class of highly organic soils, Pt. Soils on the borderline between two classes are designated by symbols for both classes, for example, CL–ML.

The AASHTO system is used to classify soils according to properties that affect their use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A–7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. If *of wildlife habitat and kinds of wildlife*—Continued

Elements of wildlife habitat—Continued			Kinds of wildlife		
Coniferous woodland plants	Wetland food and cover plants	Shallow-water developments	Openland	Woodland	Wetland
Good	Poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Very poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Very poor: slope	Very poor: slope	Fair	Good	Very poor.
Good	Very poor: slope	Very poor: slope	Fair	Good	Very poor.
Fair: poorly drained.	Good	Fair: slope	Fair	Fair	Fair.
Fair: poorly drained.	Poor: slope	Very poor: slope	Fair	Fair	Very poor.
Good	Poor: slope	Very poor: slope	Good	Good	Very poor.
Good	Poor: slope	Very poor: slope	Good	Good	Very poor.
Fair: poorly drained.	Good	Good	Fair	Fair	Good.
Fair: poorly drained.	Good	Good	Fair	Fair	Good.
Fair: poorly drained.	Good	Good	Fair	Fair	Good.
Poor: soil depth	Very poor: slope	Very poor: slope	Very poor	Poor	Very poor.
Good	Poor: moderately well drained; slope.	Very poor: slope	Good	Good	Very poor.
Poor: very poorly drained.	Good	Good	Poor	Poor	Good.

laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As an additional refinement, the engineering value of a soil material can be indicated by a group index number ranging from 0 for the best material to 20 or more for the poorest. The AASHTO classification, without group index numbers, is given in table 6 for all soils mapped in the survey area.

Soil properties significant to engineering

Estimates of soil properties significant to engineering are given in table 6. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the columns in table 6.

Depth to bedrock is not shown in the table as most soils in the survey area, except for Rock land, are deep enough over bedrock for most engineering uses.

Depth to seasonal high water table is the distance from the surface of the soil to the highest level that ground water reaches in the soil in most years.

Texture is described in the standard terms used by the United States Department of Agriculture (USDA) (*9*). These terms are based on the percentage of sand,

TABLE 5.—*Limitations of soils for specified recreational uses*

Soil series and map symbols	Camp areas	Playgrounds	Picnic areas	Paths and trails	Golf fairways
Arbela: Ar	Moderate: wetness; moderately slow permeability.	Moderate: wetness; flooding; moderately slow permeability.	Moderate: wetness; flooding.	Moderate: wetness.	Moderate: wetness.
Armstrong:					
AtC	Moderate: wetness; slow permeability.	Severe: slope	Moderate: wetness.	Slight	Slight.
AtD2	Moderate: wetness; slow permeability; slope.	Severe: slope	Moderate: wetness; slope.	Slight	Slight.
Auxvasse: Au	Severe: wetness; very slow permeability.	Severe: wetness; very slow permeability.	Severe: wetness	Severe: wetness	Severe: wetness.
Blackoar: Bk	Severe: wetness; flooding.	Severe: wetness; flooding.	Moderate: wetness; flooding.	Moderate: wetness.	Severe: wetness.
Calwoods: CaB	Moderate: wetness; slow permeability.	Moderate: wetness; slow permeability; slope.	Moderate: wetness.	Moderate: wetness.	Slight.
Chariton: Ch	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness.
Chequest: Cm	Severe: wetness; flooding.	Severe: wetness; flooding.	Severe: wetness; flooding.	Severe: wetness	Severe: wetness.
Fatima: Fa	Severe: flooding	Severe: flooding	Moderate: wetness; flooding.	Moderate: flooding.	Moderate: flooding.
Gara:					
GaD	Moderate: wetness; moderately slow permeability; slope.	Severe: slope	Moderate: wetness; slope.	Slight	Moderate: slope.
GaE	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Moderate: slope.
Gifford:					
GfB	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight.
GfC	Moderate: wetness.	Severe: very slow permeability; slope.	Moderate: wetness.	Moderate: wetness.	Slight.
Gorin: GoC2	Moderate: wetness; slow permeability.	Moderate: wetness; slow permeability; slope.	Moderate: wetness.	Moderate: wetness.	Slight.
Gosport:					
GpC	Severe: very slow permeability.	Severe: very slow permeability; slope.	Moderate: wetness; silty clay loam surface layer.	Moderate: silty clay loam surface layer.	Slight.
GpD	Severe: very slow permeability.	Severe: very slow permeability; slope.	Moderate: wetness; slope; silty clay loam surface layer.	Moderate: silty clay loam surface layer.	Moderate: slope.
GpE	Severe: very slow permeability; slope.	Severe: very slow permeability; slope.	Severe: slope	Moderate: silty clay loam surface layer; slope.	Moderate: slope.
Goss: GsF	Severe: slope; stoniness.	Severe: slope; stoniness.	Severe: slope; stoniness.	Severe: slope; stoniness.	Severe: slope; stoniness.
Keswick:					
KeC2	Moderate: wetness; slow permeability.	Moderate: wetness; slow permeability.	Moderate: wetness.	Slight	Slight.

TABLE 5.—*Limitations of soils for specified recreational uses*—Continued

Soil series and map symbols	Camp areas	Playgrounds	Picnic areas	Paths and trails	Golf fairways
Keswick, continued:					
KeD2	Moderate: wetness; slow permeability; slope.	Severe: slope	Moderate: wetness; slope.	Slight	Slight.
Kickapoo: Kk	Severe: flooding	Severe: flooding	Moderate: wetness; flooding.	Moderate: flooding.	Moderate: flooding.
Kilwinning: KlB	Severe: very slow permeability.	Severe: very slow permeability.	Moderate: wetness.	Moderate: wetness.	Slight.
Leonard:					
LcC2	Moderate: wetness; slow permeability.	Moderate: wetness; slow permeability.	Moderate: wetness.	Moderate: wetness.	Moderate: slope.
LcD2	Moderate: slow permeability; slope.	Severe: slope	Moderate: wetness; slope.	Moderate: wetness.	Moderate: slope.
Lindley:					
LdE	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Moderate: slope.
LdF	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Severe: slope.
Marion:					
MaA, MaB	Severe: wetness; very slow permeability.	Severe: wetness; very slow permeability.	Severe: wetness	Severe: wetness	Severe: wetness.
Mexico:					
MeB, MeB2	Severe: very slow permeability.	Severe: very slow permeability.	Moderate: wetness.	Moderate: wetness.	Slight.
Moniteau: Mo	Severe: wetness; flooding.	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness.
Piopolis: Po	Severe: wetness; flooding.	Severe: wetness; flooding.	Severe: wetness; flooding.	Severe: wetness	Severe: wetness.
Putnam: Pu	Severe: wetness; very slow permeability.	Severe: wetness; very slow permeability.	Severe: wetness	Severe: wetness	Severe: wetness.
Rock land: Rk	Severe: stoniness; slope.	Severe: stoniness; slope.	Severe: stoniness; slope.	Severe: stoniness; slope.	Severe: stoniness; slope.
Vigar: VgB	Moderate: wetness; moderately slow permeability.	Moderate: wetness; moderately slow permeability; slope.	Slight	Slight	Slight.
Wabash: Wa	Severe: wetness; flooding; very slow permeability; silty clay surface layer.	Severe: wetness; flooding; very slow permeability; silty clay surface layer.	Severe: wetness; flooding; silty clay surface layer.	Severe: wetness; silty clay surface layer.	Severe: wetness; silty clay surface layer.

silt, and clay in the part of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, as for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary at the back of this publication.

Liquid limit and *plasticity index* indicate the effect of water on the strength and consistence of soil material. As the water content of a clayey soil material, from which the particles coarser than 0.42 millimeter have been removed, is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material changes from a semisolid to a plastic state; and the liquid limit, from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range

TABLE 6.—*Estimated soil properties*

[The symbol > means more than;

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	Dominant USDA texture	Classification		Percentage less than 3 inches passing sieve—	
				Unified	AASHTO	No. 4 (4.7 mm)	No. 10 (2.0 mm)
	Feet	*Inches*					
Arbela: Ar	2–3	0–23	Silt loam	CL–ML, CL	A–4, A–6	100	100
		23–75	Silty clay loam.	CL	A–6, A–7	100	100
Armstrong: AtC, AtD2	[1]2–3	0–7	Loam	CL–ML, CL	A–4, A–6	96–100	92–100
		7–40	Silty clay	CH	A–7	100	85–95
		40–70	Clay loam	CL	A–7	100	92–100
Auxvasse: Au	[1]1–2	0–21	Silt loam	CL–ML, CL	A–4, A–6	100	100
		21–34	Silty clay	CH	A–7	100	100
		34–75	Silty clay loam.	CL	A–6, A–7	100	100
Blackoar: Bk	1–3	0–58	Silt loam	CL–ML, CL	A–4, A–6	100	100
		58–70	Fine sandy loam.	SM, SC	A–4	100	100
Calwoods: CaB	[1]1–2	0–10	Silt loam	ML	A–4	100	100
		10–26	Silty clay	CH	A–7	100	100
		26–52	Silty clay loam.	CL	A–6, A–7	100	100
		52–70	Silty clay	CH	A–7	100	100
Chariton: Ch	[1]1–2	0–16	Silt loam	CL–ML, CL	A–4, A–6	100	100
		16–42	Silty clay	CH	A–7	100	100
		42–56	Silty clay loam.	CL	A–6, A–7	100	100
		56–80	Fine sandy loam.	SM, SC	A–4	100	100
Chequest: Cm	1–3	0–80	Silty clay loam.	CL	A–6, A–7	100	100
Fatima: Fa	3–5	0–68	Silt loam	CL–ML, CL	A–4, A–6	100	100
Gara: GaD, GaE	>5	0–9	Loam	CL–ML, CL	A–4, A–6	96–100	92–100
		9–70	Clay loam	CL	A–6, A–7	96–100	92–100
Gifford: GfB, GfC	[1]1–2	0–9	Silt loam	ML	A–4, A–6	100	100
		9–30	Silty clay	CH	A–7	100	100
		30–56	Silty clay loam, clay loam.	CL	A–6, A–7	100	100
		56–68	Loamy sand	SM	A–2	100	100
Gorin: GoC2	[1]3–5	0–5	Silt loam	ML	A–4, A–6	100	100
		5–28	Silty clay	CH	A–7	100	100
		28–71	Silty clay loam, clay loam.	CL	A–6, A–7	100	100
Gosport: GpC, GpD, GpE	>5	0–5	Silty clay loam.	CL	A–6, A–7	100	100
		5–105	Silty clay and clay.	CH	A–7	100	100
Goss: GsF	>5	0–19	Cherty silt loam.	ML, CL	A–4	75–90	75–90
		19–69	Cherty silty clay.	GC, SC	A–7	45–70	40–65
Keswick: KeC2, KeD2	[1]2–3	0–12	Loam	CL–ML, CL	A–4, A–6	96–100	92–100
		12–19	Clay loam	CL	A–6, A–7	96–100	92–100
		19–36	Clay	CH	A–7	100	100
		36–60	Clay loam	CL	A–6, A–7	96–100	92–100

significant to engineering

the symbol < means less than]

Percentage less than 3 inches passing sieve—Continued		Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity	
No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
		Pct		*Inches per hour*	*Inches per inch of soil*	*pH*			
95–100	90–100	25–40	5–18	0.6–2.0	0.20–0.22	5.1–7.3	Low	Moderate	Moderate.
95–100	90–100	35–50	20–30	0.2–0.6	0.18–0.20	5.1–6.0	Moderate	High	Moderate.
85–95	52–65	18–30	4–15	0.6–2.0	0.20–0.22	6.1–6.5	Low	Moderate	Low.
85–95	80–95	50–60	30–36	0.06–2.0	0.11–0.13	4.5–5.5	High	Moderate	High.
85–95	55–75	42–50	23–28	0.2–0.6	0.14–0.16	6.6–7.3	Moderate	Moderate	Low.
95–100	85–95	25–35	5–15	0.6–2.0	0.22–0.24	4.5–5.0	Low	High	High.
95–100	94–99	50–65	30–40	<0.06	0.11–0.13	4.5–5.0	High	High	High.
95–100	90–96	35–45	20–25	<0.06	0.18–0.20	4.5–6.5	Moderate	High	High.
95–100	85–100	25–40	5–18	0.6–2.0	0.20–0.22	6.6–7.3	Low	High	Low.
70–85	36–50	10–22	2–10	2.0–6.0	0.14–0.16	6.6–7.3	Low	High	Low.
95–100	90–98	25–32	2–8	0.6–2.0	0.22–0.24	4.5–6.0	Low	Moderate	Moderate.
95–100	95–100	55–65	32–38	0.06–0.2	0.11–0.13	4.5–5.0	High	High	High.
95–100	90–96	35–45	20–25	0.06–0.2	0.18–0.20	4.5–5.0	Moderate	High	High.
95–100	94–99	50–65	30–40	0.06–0.2	0.10–0.12	6.1–6.5	High	High	Low.
95–100	85–95	25–35	5–15	0.6–2.0	0.22–0.24	4.5–6.5	Low	High	Moderate.
95–100	94–99	60–70	40–50	0.06–0.2	0.11–0.13	4.5–6.0	High	High	Moderate.
95–100	90–96	35–45	20–30	0.06–0.2	0.18–0.20	6.1–6.5	Moderate	High	Low.
70–85	36–50	10–22	2–10	2.0–6.0	0.14–0.16	6.1–6.5	Low	High	Low.
95–100	90–96	35–45	20–30	0.2–0.6	0.18–0.20	5.1–7.3	Moderate	High	Moderate.
95–100	85–100	25–40	5–18	0.6–2.0	0.20–0.22	4.5–6.5	Low	Moderate	Moderate.
85–95	52–65	18–30	4–15	0.6–2.0	0.20–0.22	6.6–7.3	Low	Moderate	Low.
85–95	55–75	32–44	16–25	0.2–0.6	0.14–0.16	4.5–7.8	Moderate	Moderate	Moderate.
90–100	85–95	30–40	5–12	0.6–2.0	0.22–0.24	5.1–6.0	Low	Moderate	Moderate.
95–100	95–100	50–65	32–38	<0.06	0.11–0.13	5.6–6.5	High	High	Moderate.
95–100	90–96	35–45	20–25	0.06–0.2	0.18–0.20	6.6–7.3	Moderate	High	Low.
50–75	15–30	<15	[2] NP-3	2.0–6.0	0.08–0.10	6.6–7.3	Low	High	Low.
90–100	85–95	30–40	5–12	0.6–2.0	0.22–0.24	4.5–7.3	Low	Moderate	Moderate.
95–100	95–100	50–65	32–38	0.06–0.2	0.11–0.13	4.5–5.0	High	High	High.
95–100	85–95	35–45	20–25	0.2–0.6	0.18–0.20	4.5–5.0	Moderate	High	High.
95–100	90–96	35–45	20–25	0.2–0.6	0.21–0.23	6.1–6.5	Moderate	Moderate	Low.
95–100	95–100	60–70	40–50	<0.06	0.08–0.12	4.5–6.0	High	High	Moderate.
75–90	70–85	20–30	2–8	2.0–6.0	0.06–0.17	5.6–6.0	Low	Low	Moderate.
40–50	35–45	50–70	30–40	0.6–2.0	0.04–0.09	5.1–7.3	Moderate	Low	Moderate.
85–95	52–65	18–30	4–15	0.6–2.0	0.20–0.22	4.5–6.0	Low	Moderate	Moderate.
85–95	55–75	32–44	16–26	0.2–0.6	0.15–0.19	4.5–5.0	Moderate	Moderate	High.
97–100	92–99	55–75	30–45	0.06–0.2	0.09–0.11	4.5–5.5	High	High	High.
85–95	55–75	32–44	16–26	0.2–0.6	0.14–0.16	6.1–7.8	Moderate	Moderate	Low.

TABLE 6.—*Estimated soil properties*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	Dominant USDA texture	Classification		Percentage less than 3 inches passing sieve—	
				Unified	AASHTO	No. 4 (4.7 mm)	No. 10 (2.0 mm)
	Feet	*Inches*					
Kickapoo: Kk	3–5	0–65	Fine sandy loam.	SM, SC	A–4	100	100
Kilwinning: KlB	[1] 1½–2	0–7	Silt loam	CL–ML, CL	A–4, A–6	100	100
		7–28	Silty clay	CH	A–7	100	100
		28–40	Silty clay loam.	CL	A–6, A–7	100	100
		40–66	Silt loam	CL	A–6	100	100
Leonard: LcC2, LcD2	[1] 1½–2	0–7	Silt loam	CL–ML, CL	A–4, A–6	100	100
		7–78	Silty clay	CH	A–7	100	100
Lindley: LdE, LdF	>5	0–11	Loam	CL–ML, CL	A–4, A–6	96–100	92–100
		11–48	Clay loam	CL	A–6, A–7	96–100	92–100
		48–82	Loam	CL	A–6	96–100	92–100
Marion: MaA, MaB	1–2	0–12	Silt loam	CL–ML, CL	A–4, A–6	100	100
		12–30	Silty clay	CH	A–7	100	100
		30–60	Silty clay loam	CL	A–6, A–7	100	100
Mexico: MeB, MeB2	[1] 2–3	0–8	Silt loam	CL	A–6	100	100
		8–12	Silty clay loam	CH	A–7	100	100
		12–30	Silty clay	CH	A–7	100	100
		30–74	Silty clay loam, silt loam.	CH	A–7	100	100
Moniteau: Mo	1–3	0–17	Silt loam	ML, CL	A–4	100	100
		17–43	Silty clay loam	CL	A–6, A–7	100	100
		43–78	Silt loam	CL–ML, CL	A–4	100	100
Piopolis: Po	1–3	0–62	Silty clay loam	CL	A–6	100	100
Putnam: Pu	[1] 1–2	0–17	Silt loam	CL	A–6	100	100
		17–34	Silty clay	CH	A–7	100	100
		34–80	Silty clay loam	CL	A–7	100	100
Rock land: Rk. Too variable to be rated.							
Vigar: VgB	2–3	0–17	Loam	CL–ML, CL	A–4	96–100	92–100
		17–61	Clay loam	CL	A–6	96–100	92–100
Wabash: Wa	1–2	0–74	Silty clay	CH	A–7	100	100

[1] Seasonal perched water table above silty clay or clay.

of water content within which a soil material is plastic. Liquid limit and plasticity index are estimated in table 6.

Permeability is an estimate of the rate at which saturated soil would transmit water vertically under a unit head of pressure. It is estimated on the basis of soil characteristics observed in the field, particularly structure, porosity, and texture. Lateral seepage or such transient soil features as plowpans and surface crusts are not considered.

Available water capacity is an estimate of the capacity of soils to hold water for use by most plants. It is defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most plants.

Reaction refers to the acidity or alkalinity of a soil, expressed in pH values for a stated soil-solution mixture. The pH value and terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential refers to the relative change in volume to be expected of soil material when the moisture content changes, that is, the extent to which the soil shrinks as it dries or swells when it gets wet. Soils that have a high shrink-swell potential can damage building foundations, roads, and other structures.

Corrosivity, as used in table 6, pertains to potential soil-induced chemical action that dissolves or weakens steel or concrete. Rate of corrosion of steel is related to such soil properties as drainage, texture, total acidity, and electrical conductivity of the soil material. Installations of steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than instal-

significant to engineering—Continued

Percentage less than 3 inches passing sieve—Continued		Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity	
No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
		Pct		*Inches per hour*	*Inches per inch of soil*	*pH*			
70–85	36–50	10–22	2–10	2.0–6.0	0.14–0.16	5.1–6.5	Low	Low	Moderate.
95–100	90–98	30–40	8–20	0.6–2.0	0.22–0.24	6.6–7.3	Low	Moderate	Low.
95–100	95–100	55–65	36–46	<0.06	0.11–0.13	5.1–6.5	High	High	Moderate.
95–100	85–95	35–45	20–25	<0.06	0.18–0.20	6.6–7.3	Moderate	High	Low.
90–100	70–90	25–35	11–20	0.6–2.0	0.20–0.22	6.6–7.3	Low	High	Low.
90–100	85–95	25–35	6–12	0.6–2.0	0.22–0.24	6.6–7.3	Low	Moderate	Low.
95–100	95–100	60–70	32–42	0.06–0.2	0.10–0.12	4.5–7.3	High	High	Moderate.
85–95	52–65	18–30	4–15	0.6–2.0	0.20–0.22	4.5–5.0	Low	Moderate	High.
85–95	55–75	32–44	16–26	0.2–0.6	0.15–0.19	4.5–5.0	Moderate	Moderate	High.
85–95	50–70	30–38	14–24	0.2–0.6	0.17–0.19	6.6–7.3	Moderate	Moderate	Low.
90–100	85–95	30–40	8–18	0.6–2.0	0.22–0.24	4.5–7.3	Low	High	Moderate.
95–100	90–95	50–65	30–40	<0.06	0.11–0.13	5.1–5.5	High	High	Moderate.
95–100	85–95	35–45	20–25	<0.06	0.18–0.20	5.1–5.5	Moderate	High	Moderate.
95–100	90–98	30–40	10–20	0.6–2.0	0.22–0.24	6.6–7.3	Low	Moderate	Low.
95–100	92–100	60–75	38–50	<0.06	0.21–0.23	6.1–6.5	High	High	Low.
95–100	95–100	62–78	40–52	<0.06	0.11–0.13	5.1–6.0	High	High	Moderate.
95–100	90–100	60–75	40–50	<0.06	0.15–0.20	6.1–6.5	High	High	Low.
90–100	80–95	20–28	2–8	0.6–2.0	0.22–0.24	4.5–6.0	Low	High	Moderate.
95–100	85–95	35–50	20–30	0.06–0.2	0.18–0.20	4.5–5.0	Moderate	High	High.
90–100	75–95	20–28	4–10	0.6–2.0	0.20–0.22	4.5–5.0	Low	High	High.
95–100	85–95	30–40	15–20	0.06–0.2	0.18–0.20	5.1–6.5	Moderate	High	Moderate.
90–100	85–98	32–40	10–20	0.6–2.0	0.22–0.24	4.5–6.5	Low	High	Moderate.
95–100	92–99	65–78	38–48	<0.06	0.11–0.13	4.5–5.5	High	High	High.
95–100	92–99	42–50	22–28	0.06–0.2	0.18–0.20	4.5–6.0	Moderate	High	Moderate.
85–95	52–65	20–30	4–10	0.6–2.0	0.20–0.22	6.1–6.5	Low	Moderate	Low.
85–95	55–75	25–38	15–25	0.2–0.6	0.14–0.16	5.6–7.8	Moderate	High	Moderate.
100	95–100	52–78	30–55	<0.06	0.10–0.12	4.5–7.3	High	High	Moderate.

[3] NP = Nonplastic.

lations entirely in one kind of soil or in one soil horizon. Corrosivity for concrete is influenced mainly by the content of sodium or magnesium sulfate, but also by soil texture and acidity. A corrosivity rating of *low* means that there is a low probability of soil-induced corrosion damage. A rating of *high* means that there is a high probability of damage, so that protective measures for steel and more resistant concrete should be used.

Engineering interpretations

The interpretations (*12*) in table 7 are based on the estimated engineering properties of soils shown in table 6, on test data for soils in nearby areas, and on the experience of engineers and soil scientists with the soils in Knox, Monroe, and Shelby Counties. In table 7, ratings are used to summarize limitations or suitability of the soils for all listed uses of soils other than pond reservoir areas; embankments, dikes, and levees; drainage; irrigation; and terraces and diversions. For these uses, table 7 lists soil features not to be overlooked in planning, installation, and maintenance.

Soil limitations are rated *slight, moderate,* or *severe. Slight* means that soil properties are generally favorable for the rated use, or that limitations are minor and easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* means that soil properties are so unfavorable and so difficult to correct or overcome as to require major soil reclamation, special designs, or intensive maintenance.

Soil suitability is rated *good, fair,* or *poor,* terms

TABLE 7.—*Engineering*

Soil series and map symbols	Degree and kind of limitations for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basements	Sanitary landfill [1]	Local roads and streets
Arbela: Ar	Severe: moderately slow permeability; seasonal high water table; occasional flooding.	Severe: seasonal high water table; occasional flooding.	Severe: somewhat poorly drained; occasional flooding.	Moderate: somewhat poorly drained; seasonal high water table; moderate shrink-swell potential.	Severe: seasonal high water table; occasional flooding.	Moderate: somewhat poorly drained; occasional flooding; moderate shrink-swell potential.
Armstrong: AtC, AtD2.	Severe: slow permeability.	Severe if slope is more than 5 percent.	Moderate if slope is 5 to 14 percent: moderately well drained.	Severe: high shrink-swell potential.	Moderate: moderately well drained; clay loam subsoil.	Severe: high shrink-swell potential.
Auxvasse: Au	Severe: very slow permeability.	All features favorable.	Severe: poorly drained.	Severe: poorly drained; high shrink-swell potential.	Severe: poorly drained.	Severe: poorly drained; high shrink-swell potential.
Blackoar: Bk	Severe: seasonal high water table; occasional flooding.	Severe: seasonal high water table; occasional flooding.	Severe: poorly drained; occasional flooding.	Severe: poorly drained; occasional flooding; low strength.	Severe: seasonal high water table; poorly drained; occasional flooding.	Severe: poorly drained; occasional flooding; low strength.
Calwoods: CaB	Severe: slow permeability.	Moderate if slope is 2 to 5 percent.	Severe: somewhat poorly drained.	Severe: high shrink-swell potential.	Moderate: somewhat poorly drained; dominantly silty clay loam.	Severe: high shrink-swell potential.
Chariton: Ch	Severe: slow permeability.	All features favorable.	Severe: poorly drained.	Severe: poorly drained; high shrink-swell potential.	Severe: poorly drained.	Severe: poorly drained; high shrink-swell potential.
Chequest: Cm	Severe: moderately slow permeability; seasonal high water table; occasional flooding.	Severe: seasonal high water table; occasional flooding.	Severe: poorly drained; occasional flooding.	Severe: poorly drained; occasional flooding.	Severe: seasonal high water table; poorly drained; occasional flooding.	Severe: poorly drained; occasional flooding.
Fatima: Fa	Severe: seasonal high water table; occasional flooding.	Severe: seasonal high water table; occasional flooding.	Severe: occasional flooding.	Severe: occasional flooding.	Severe: seasonal high water table; occasional flooding.	Severe: occasional flooding.
Gara: GaD, GaE	Severe: moderately slow permeability.	Severe if slope is more than 9 percent.	Moderate if slope is 9 to 14 percent. Severe if slope is more than 14 percent.	Moderate if slope is 9 to 14 percent. Severe if slope is more than 14 percent.	Moderate: moderately well drained; clay loam subsoil.	Moderate if slope is 9 to 14 percent: moderate shrink-swell potential. Severe if slope is more than 14 percent.

interpretations

Suitability as a source of—		Soil features affecting—				
Road fill	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage of crops and pasture	Irrigation	Terraces and diversions
Fair: moderate shrink-swell potential; somewhat poorly drained.	Good: friable silt loam texture; material more than 16 inches thick.	Most features favorable; suitable sites unlikely.	Fair compaction characteristics.	Moderately slow permeability; seasonal high water table; occasional flooding.	High available water capacity; moderately slow permeability.	Not needed.
Poor: high shrink-swell potential.	Poor: limited thickness of suitable material.	All features favorable.	Fair compaction characteristics; low permeability.	Not needed	Slope; susceptible to water erosion.	All features favorable.
Poor: high shrink-swell potential; poorly drained.	Poor: poorly drained.	All features favorable.	Fair to poor compaction characteristics; medium to low permeability.	Very slow permeability; claypan at depth of 21 inches.	High available water capacity; very slow permeability; claypan at depth of 21 inches.	Not needed.
Poor: poorly drained; low strength.	Poor: poorly drained.	Moderate permeability; suitable sites unlikely.	High susceptibility to piping; fair to poor compaction characteristics.	Seasonal high water table; occasional flooding.	Very high available water capacity; occasional flooding.	Not needed.
Poor: high shrink-swell potential.	Fair: material 8 to 16 inches thick.	All features favorable.	Fair to poor compaction characteristics; low permeability.	Not needed	Slope; susceptible to water erosion; slow permeability.	All features favorable.
Poor: high shrink-swell potential; poorly drained.	Poor: poorly drained.	All features favorable.	Fair to poor compaction characteristics; low permeability.	Slow permeability; claypan at depth of 16 inches.	Undulating topography; slow intake rate; claypan at depth of 16 inches.	Not needed.
Poor: poorly drained.	Poor: poorly drained.	Most features favorable; suitable sites unlikely.	Fair to good compaction characteristics; low permeability.	Moderately slow permeability; seasonal high water table; occasional flooding.	High available water capacity; slow intake rate.	Not needed.
Good: low shrink-swell potential; moderately well drained.	Good: friable silt loam texture; material more than 5 feet thick.	Moderate permeability; suitable sites unlikely.	High susceptibility to piping; fair to poor compaction characteristics.	Not needed	All features favorable.	Not needed.
Good if slope is 9 to 14 percent. Fair if slope is 14 to 20 percent: moderate shrink-swell potential.	Fair if slope is 9 to 14 percent: material 8 to 16 inches thick. Poor if slope is 14 to 20 percent.	All features favorable.	Fair to good compaction characteristics; low permeability.	Not needed	Strongly sloping to moderately steep.	Slope is 9 to 20 percent.

TABLE 7.—*Engineering*

Soil series and map symbols	Degree and kind of limitations for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basements	Sanitary landfill [1]	Local roads and streets
Gifford: GfB, GfC.	Severe: very slow permeability.	Moderate if slope is 2 to 9 percent.	Severe: somewhat poorly drained.	Severe: high shrink-swell potential.	Moderate: somewhat poorly drained; dominantly silty clay loam.	Severe: high shrink-swell potential.
Gorin: GoC2	Severe: slow permeability.	Moderate if slope is 5 to 9 percent.	Severe: somewhat poorly drained.	Severe: high shrink-swell potential.	Moderate: somewhat poorly drained; dominantly silty clay loam.	Severe: high shrink-swell potential.
Gosport: GpC, GpD, GpE.	Severe: very slow permeability.	Severe if slope is more than 5 percent.	Moderate if slope is 5 to 14 percent: moderately well drained. Severe if slope is more than 14 percent.	Severe: high shrink-swell potential.	Severe: silty clay and clay subsoil.	Severe: high shrink-swell potential.
Goss: GsF	Severe if slope is more than 24 percent: stoniness; coarse cherty fragments throughout profile.	Severe if slope is more than 20 percent: coarse cherty fragments more than 50 percent by volume; hazard of seepage.	Severe if slope is more than 20 percent: coarse cherty fragments within depth of 40 inches.	Severe if slope is more than 20 percent: coarse cherty fragments within depth of 20 inches.	Severe if slope is more than 20 percent: coarse cherty fragments at depth of less than 60 inches.	Severe if slope is more than 20 percent.
Keswick: KeC2, KeD2.	Severe: slow permeability.	Moderate if slope is 5 to 9 percent. Severe if slope is 9 to 14 percent.	Moderate if slope is 5 to 14 percent: moderately well drained.	Severe: high shrink-swell potential.	Moderate: moderately well drained; clay loam subsoil.	Severe: high shrink-swell potential.
Kickapoo: Kk	Severe: seasonal high water table; occasional flooding.	Severe: seasonal high water table; occasional flooding.	Severe: occasional flooding.	Severe: occasional flooding.	Severe: seasonal high water table; occasional flooding.	Moderate: occasional flooding.
Kilwinning: KlB	Severe: very slow permeability.	Moderate if slope is 2 to 5 percent.	Severe: somewhat poorly drained.	Severe: high shrink-swell potential.	Moderate: somewhat poorly drained; dominantly silty clay loam.	Severe: high shrink-swell potential.
Leonard: LcC2, LcD2.	Severe: slow permeability.	Moderate if slope is 5 to 9 percent. Severe if slope is 9 to 14 percent.	Severe: somewhat poorly drained.	Severe: high shrink-swell potential.	Severe: silty clay subsoil.	Severe: high shrink-swell potential.
Lindley: LdE, LdF.	Severe if slope is more than 14 percent: moderately slow permeability.	Severe if slope is more than 14 percent.	Severe if slope is more than 14 percent.	Severe if slope is more than 14 percent.	Moderate if slope is 14 to 20 percent: clay loam subsoil. Severe if slope is more than 20 percent.	Severe if slope is more than 14 percent.

interpretations—Continued

Suitability as a source of—		Soil features affecting—				
Road fill	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage of crops and pasture	Irrigation	Terraces and diversions
Poor: high shrink-swell potential.	Poor: limited thickness of suitable material.	All features favorable.	Fair to poor compaction characteristics; low permeability.	Not needed	Slope; susceptible to water erosion; very slow permeability.	Short slopes.
Poor: high shrink-swell potential.	Poor: limited thickness of suitable material.	All features favorable.	Fair to poor compaction characteristics; low permeability.	Not needed	Slope; susceptible to water erosion; slow permeability.	All features favorable.
Poor: high shrink-swell potential.	Poor: material mostly silty clay and clay texture; limited thickness of suitable material.	All features favorable.	Fair to poor compaction characteristics; low permeability.	Not needed	Slope; susceptible to water erosion; slow intake rate.	Clayey subsoil; slope is 5 to 20 percent.
Poor if slope is more than 20 percent.	Poor if slope is more than 20 percent: limited thickness of suitable material; coarse fragments more than 15 percent.	Bedrock at depth of 5 to 7 feet in places; moderate permeability; hazard of seepage.	Fair compaction characteristics; medium to low permeability.	Not needed	Unsuitable: steep; cherty profile.	Cherty soil; steep.
Poor: high shrink-swell potential.	Fair if slope is 5 to 14 percent: material 8 to 16 inches thick.	All features favorable.	Fair compaction characteristics; low permeability.	Not needed	Slope; susceptible to water erosion; slow intake rate.	All features favorable.
Good: low shrink-swell potential; moderately well drained.	Good: fine sandy loam texture; material more than 5 feet thick.	Moderately rapid permeability; suitable sites unlikely.	Medium to high susceptibility to piping; fair to good compaction characteristics.	Not needed	High available water capacity; rapid intake rate.	Not needed.
Poor: high shrink-swell potential.	Poor: limited thickness of suitable material.	All features favorable.	Fair to good compaction characteristics.	Not needed	Slope; susceptible to water erosion; very slow permeability.	All features favorable.
Poor: high shrink-swell potential.	Poor: limited thickness of suitable material.	All features favorable.	Fair to poor compaction characteristics; low permeability.	Not needed	Slope; susceptible to water erosion; slow permeability.	All features favorable.
Fair if slope is 14 to 20 percent: moderate shrink-swell potential. Poor if slope is more than 20 percent.	Poor if slope is more than 14 percent: limited thickness of suitable material.	All features favorable.	Fair to good compaction characteristics; low permeability.	Not needed	Steep; moderately slow permeability.	Slope is 14 to 30 percent.

TABLE 7.—*Engineering*

Soil series and map symbols	Degree and kind of limitations for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basements	Sanitary landfill [1]	Local roads and streets
Marion: MaA, MaB.	Severe: very slow permeability; seasonal high water table.	Slight if slope is 0 to 2 percent. Moderate if slope is 2 to 5 percent.	Severe: poorly drained; seasonal high water table.	Severe: poorly drained; high shrink-swell potential; seasonal high water table.	Severe: poorly drained; seasonal high water table.	Severe: poorly drained; high shrink-swell potential.
Mexico: MeB, MeB2.	Severe: very slow permeability; seasonal high water table.	Moderate if slope is 2 to 5 percent: seasonal high water table.	Severe: somewhat poorly drained.	Severe: high shrink-swell potential.	Severe: seasonal high water table.	Severe: high shrink-swell potential.
Moniteau: Mo	Severe: slow permeability; seasonal high water table; occasional flooding.	Severe: seasonal high water table; occasional flooding.	Severe: poorly drained; seasonal high water table; occasional flooding.	Severe: poorly drained; seasonal high water table; occasional flooding.	Severe: seasonal high water table; poorly drained; occasional flooding.	Severe: poorly drained; occasional flooding.
Piopolis: Po	Severe: slow permeability; seasonal high water table; occasional flooding.	Severe: seasonal high water table; occasional flooding.	Severe: poorly drained; seasonal high water table; occasional flooding.	Severe: poorly drained; seasonal high water table; occasional flooding.	Severe: seasonal high water table; poorly drained; occasional flooding.	Severe: poorly drained; occasional flooding.
Putnam: Pu	Severe: very slow permeability; seasonal high water table.	Severe: seasonal high water table.	Severe: poorly drained; seasonal high water table.	Severe: poorly drained; seasonal high water table; high shrink-swell potential.	Severe: seasonal high water table; poorly drained.	Severe: poorly drained; high shrink-swell potential.
Rock land: Rk. Too variable to be rated.						
Vigar: VgB	Severe: moderately slow permeability; seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: seasonal high water table.	Moderate: moderate shrink-swell potential.
Wabash: Wa	Severe: very slow permeability; seasonal high water table; occasional flooding.	Severe: seasonal high water table; occasional flooding.	Severe: very poorly drained; seasonal high water table; occasional flooding.	Severe: very poorly drained; seasonal high water table; occasional flooding; high shrink-swell potential.	Severe: seasonal high water table; very poorly drained; occasional flooding; silty clay soil.	Severe: very poorly drained; occasional flooding; high shrink-swell potential.

[1] Onsite study is needed of the deep underlying strata, the water table, and the hazards of aquifer pollution and drainage into

interpretations—Continued

Suitability as a source of—		Soil features affecting—				
Road fill	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage of crops and pasture	Irrigation	Terraces and diversions
Poor: high shrink-swell potential; poorly drained.	Poor: poorly drained.	All features favorable; suitable sites unlikely.	Fair compaction characteristics; low permeability.	Very slow permeability; claypan at depth of 12 inches; not needed if slope is 2 to 5 percent.	Very slow permeability; claypan at depth of 12 inches; slope is 2 to 5 percent; susceptible to water erosion.	Not needed if slope is 0 to 2 percent; all features favorable if slope is 2 to 5 percent.
Poor: high shrink-swell potential.	Fair: material 8 to 16 inches thick.	All features favorable.	Fair compaction characteristics; low permeability.	Not needed -----	Slope; susceptible to water erosion; very slow permeability.	All features favorable.
Poor: poorly drained.	Poor: poorly drained.	Most features favorable; suitable sites unlikely.	Fair compaction characteristics; low permeability.	Slow permeability; seasonal high water table; occasional flooding.	High available water capacity; slow permeability; occasional flooding.	Not needed.
Poor: poorly drained.	Poor: poorly drained.	Most features favorable; suitable sites unlikely.	Fair to good compaction characteristics; low permeability.	Slow permeability; seasonal high water table; occasional flooding.	High available water capacity; slow intake rate; slow permeability; occasional flooding.	Not needed.
Poor: high shrink-swell potential; poorly drained.	Poor: poorly drained.	Most features favorable; suitable sites unlikely.	Fair to poor compaction characteristics; low permeability.	Very slow permeability; claypan at depth of 17 inches.	Very slow permeability; claypan at depth of 17 inches.	Not needed.
Fair: moderate shrink-swell potential.	Good: loam texture; material more than 16 inches thick.	All features favorable.	Fair compaction characteristics; medium permeability.	Not needed -----	Slope; susceptible to water erosion; moderate intake rate.	All features favorable.
Poor: high shrink-swell potential; very poorly drained.	Poor: very poorly drained; silty clay texture.	Most features favorable; suitable sites unlikely.	Fair to poor compaction characteristics; low permeability.	Very slow permeability; seasonal high water table; occasional flooding.	Very slow intake rate; occasional flooding.	Not needed.

ground water in landfill deeper than 5 or 6 feet.

whose meanings are similar, respectively, to the terms slight, moderate, and severe.

Following are explanations of the columns in table 7.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material between depths of 18 inches and 5 feet is evaluated. Soil properties considered affect both absorption of effluent and construction and operation of the system. Permeability, depth to water table or rock, and susceptibility to flooding affect absorption. Slope affects difficulty of layout and construction and also the hazard of erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet until bacteria can decompose the solids. A lagoon has a nearly level floor and sides, or embankments, of compacted soil material. It is assumed that the embankment is compacted to medium density and the pond is protected from flooding. Soil properties considered affect the lagoon floor and the embankment. Permeability, organic-matter content, and slope affect the lagoon floor; if the floor needs to be leveled, depth to bedrock is important. Properties that affect the embankment are the engineering properties of the embankment material as interpreted from the Unified soil classification, and the amount of stones, which affects ease of excavation and compaction of the embankment material.

Shallow excavations require digging or trenching to a depth of less than 6 feet, as for example, excavations for pipelines, sewer lines, phone and power transmission lines, basements, open ditches, and cemeteries. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops or large stones, and freedom from flooding or a high water table.

Dwellings without basements are no more than three stories high and are supported by foundation footings placed in undisturbed soil. Soil properties considered relate to capacity to support load and resist settlement under load, and to ease of excavation. Wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential affect capacity to support load. Wetness, slope, depth to bedrock, and content of stones and rocks affect excavation.

Sanitary landfill is a method of disposing of refuse in dug trenches. The waste is spread in thin layers, compacted, and covered with soil throughout the disposal period. Landfill areas are subject to heavy vehicular traffic. Soil properties considered relate to ease of excavation, hazard of polluting ground water, and trafficability. Suitable soils have moderately slow permeability, can withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated the ratings in table 7 apply only to a depth of about 6 feet, and therefore ratings of *slight* or *moderate* are not valid for some soils if trenches are much deeper than that. For some soils, reliable predictions can be made to a depth of 10 or 15 feet, but regardless of that, every site should be investigated before a selection is made.

Local roads and streets have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep.

Soil properties considered are those that affect load-supporting capacity and stability of the subgrade, and the workability and quantity of available cut and fill material. The AASHTO and Unified classifications of the soil material and the shrink-swell potential indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, wetness, depth to hard rock, and the presence of stones and rocks affect ease of excavation and amount of cut and fill needed to reach an even grade.

Road fill is soil material used in embankments for roads. Soil properties considered are those that affect (1) the performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage, and (2) the relative ease of excavating the material at borrow areas.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Soil properties considered are those that affect ease of working and spreading the soil material, as for preparing a seedbed; natural fertility of the soil or the response of plants on the soil to application of fertilizer; and absence of substances toxic to plants. Texture of the soil and its content of stone fragments affect suitability, but also considered in the ratings is damage that will result at the area from which topsoil is taken.

The soils in the survey area are not rated in table 7 as a source of sand and gravel, because the soils are generally not suited to this use.

Pond reservoir areas hold water behind a dam or embankment. Suitable soils have a slow rate of seepage, which is related to their permeability and the depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Presence of stones or organic material in a soil are unfavorable characteristics.

Drainage of crops and pasture is affected by such properties as permeability, texture, and structure; depth to claypan, rock, or other layers that influence rate of water movement; depth to the water table; slope; stability in ditchbanks; susceptibility to stream overflow; salinity or alkalinity; and availability of outlets for drainage.

Irrigation of a soil is affected by such properties as slope; susceptibility to stream overflow, water erosion, or soil blowing; soil texture; content of stones; accumulations of salts and alkali; depth to which roots can penetrate; rate of water intake at the surface; permeability of soil layers below the surface layer and in fragipans or other layers that restrict movement of water; available water capacity; and need for drainage or depth to water table or bedrock.

Terraces and diversions are embankments or ridges constructed across slopes to intercept runoff water so that it soaks into the soil or flows slowly to a prepared outlet. Soil properties considered are uniformity and steepness of slope; depth to bedrock or other unfavorable material; presence of stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. Suitable soils provide outlets for runoff and are not difficult to vegetate.

Formation and Classification of the Soils

This section discusses factors that have affected the formation of soils in Knox, Monroe, and Shelby Counties. It also explains the current system of soil classification and classifies each soil series in the survey area according to that system. A description of each soil series in the area and a representative profile of each series can be found in the section "Descriptions of the Soils."

Factors of Soil Formation

Soil is produced when soil-forming processes act on material deposited or accumulated by geologic agencies. The characteristics of a soil at any given point are determined by (1) the physical and mineralogical composition of the parent material; (2) the plant and animal life on and in the soil; (3) the climate under which the soil material has accumulated and existed since accumulation; (4) the relief, or lay of the land; and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and vegetation are active forces in soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body that has genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent material also affects the kind of profile that can be formed and, in extreme cases, determines it almost entirely. Finally, time is needed to change the parent material into a soil profile. Generally a long time is required for the development of distinct horizons.

Parent material

Parent material is the unconsolidated mass in which a soil forms. It determines the limits of the chemical and mineral composition of the soil. In Knox, Monroe, and Shelby Counties, soils formed in four kinds of parent material, alone or in combinations of two or more. These four kinds of material are residual, or bedrock; glacial, or ice deposited; loessial, or wind deposited; and alluvial, or water deposited.

Limestone and shale as residual parent material have weathered to form Gosport and Goss soils, and as rock outcrop they form the land type Rock land.

Glacial parent material, consisting of sand, silt, clay, and gravel, along with large boulders was transported by ice action. Armstrong, Gara, Keswick, and Lindley soils formed in glacial material.

Loessial parent material consisting mostly of silt and clay was transported by wind action. Kilwinning, Marion, Mexico, and Putnam soils formed in loessial material.

Alluvial parent material in the area generally is of local origin. It consists of silt, sand, clay, and gravel transported by water action from ridges and hillsides to flood plains of adjacent streams. Such soils as Arbela, Blackoar, Fatima, Moniteau, Piopolis, and Wabash formed in alluvial parent material.

Some soils in the survey area formed in more than one kind of parent material. For example, Calwoods, Gorin, and Leonard soils formed in a thin layer of loessial material overlying glacial material.

Climate

Climate is an important factor in the formation of soils in Knox, Monroe, and Shelby Counties. The early climate in these counties resulted in the ice- and wind-deposited parent materials. Recent climate has affected, directly or indirectly, the formation of soils in these and other materials. Geologic erosion, plant and animal life, and accelerated erosion all vary with the climate and all influence soil formation. Temperature is quite variable over relatively short periods of time. It varies as much as 50° in a few hours when warm and cold fronts move across the area. Rainfall combined with use of the land and farming operations has a marked effect on the soils of these counties. Average annual precipitation is about 39 inches. About two-thirds of the precipitation falls from April through September, the same period when most seedbed preparation and tillage operations are performed. The eroded phases of Armstrong, Gorin, Keswick, Leonard, and Mexico soils are a direct result of climatic influence.

Plant and animal life

Plants, animals, insects, bacteria, and fungi are important in the formation of soils. Gains of organic matter and nitrogen in the soil, gains or losses of plant nutrients, and changes in structure and porosity are among the changes caused by living organisms.

In Knox, Monroe, and Shelby Counties, two main kinds of vegetation, prairie grasses and trees, produced a noticeable effect in the soils. For example, soils formed under prairie grasses have a darker colored, thicker surface layer than soils formed under deciduous trees. This is mainly because the large amount of dense, fine grass roots decay faster and add a larger amount of organic matter throughout the surface layer. Bacterial activity is high. Soils that formed under grass make up about 63 percent of the acreage in the Area and include Armstrong, Chariton, Gara, Gifford, Kilwinning, Leonard, Mexico, and Putnam soils.

Soils that formed under deciduous trees have a lighter colored subsurface layer, are more acid, and have a very thin, dark-colored surface layer. This is because decomposition of leaves in the surface layer develops solvent acids that leach the subsurface layer and the subsoil. Also, in the surface layer there are more fungi and less bacteria and earthworm activity. Auxvasse, Calwoods, Gorin, Gosport, Goss, Keswick, Lindley, and Marion soils formed under deciduous trees. These soils are along and adjacent to streams and on narrow ridgetops.

Relief

Topography, or relief, affects soil formation through its influence on drainage, runoff, infiltration, and other related factors, including accelerated erosion. In areas that have about the same amount of plant cover and rainfall, runoff is rapid on steep slopes. It is slow or very slow in the nearly level areas on uplands. It has affected the formation of Putnam soils in these areas. These soils have very slow permeability, a leached light-gray subsurface horizon, and a dense claypan. They formed under grass, which grows well in these wet, nearly level upland areas. Rapid runoff on steep slopes causes erosion; even under native vegetation the soils eroded as they were forming. Deciduous trees grow better on well-drained soils than on those not so well drained, and they have contributed to the formation of Lindley and Keswick soils on the steeper slopes.

Both the gradient of slopes and the direction they face influence soil temperature. South-facing slopes thaw out and warm up earlier in spring and cool off more slowly in fall than north-facing slopes. Steeper, better drained slopes also warm up earlier in spring.

Time

Usually a long time is required for the formation of distinct soil horizons. The length of time a parent material has been in place, therefore, is commonly reflected in the degree of development of the soil profile.

The older soils in Knox, Monroe, and Shelby Counties are on uplands, and they formed in residuum, glacial till, or loess. Putnam and Lindley soils are examples. The parent material has been in place thousands of years, and the soils have developed well-defined horizons. The weathering process has moved the fine particles downward. They have accumulated in the subsoil, making it more clayey than the surface layer. Also, some of the minerals and humus have been leached out of the surface layer, resulting in a light-colored subsurface layer in some of the soils.

In some areas steep rocky material has been exposed by geologic erosion. This material, although very old, has not had time to develop into soil. Rock land and Goss soils are examples. Young soils are forming near streams, where overflow deposits new material from time to time. Fatima and Piopolis are examples of young soils.

Classification of Soils

Soils are classified according to a system designed to make it easy to remember their characteristics and interrelationships. Classification makes it easier to organize and apply the results of experience and research. Soils are placed in narrow classes for discussion in detailed soil surveys and for management within farms and fields. The many thousands of narrow classes are then grouped into fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

The system currently used by the National Cooperative Soil Survey for classifying soils in the United States was adopted in 1965 (*10*). It is under continual study.[4]

The current system of classification has six categories. Beginning with the most inclusive, these categories are order, suborder, great group, subgroup, family, and series. The criteria for classification are soil properties that are observable or measurable, and the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 8 shows the classification of each soil series of Knox, Monroe, and Shelby Counties by family, subgroup, and order.

ORDERS. Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. Three exceptions to this are the Entisols, Histosols, and Vertisols, which are found in many different kinds of climate. The name of each order is a word of three or four syllables ending in *sol* (Moll-i-sol). The four orders in Knox, Monroe, and Shelby Counties are Mollisols, Alfisols, Entisols, and Inceptisols. Mollisols have a thick, dark-colored surface layer, moderate to strong structure, and base saturation of more than 35 percent. Alfisols contain accumulated aluminum and iron, have argillic or natric horizons, and have a base saturation of more than 35 percent. Entisols are young soils that show little, if any, horizon development. Inceptisols are mineral soils whose horizons have definitely started to develop. They generally are young soils.

SUBORDERS. Each order is divided into suborders on the basis of soil characteristics that seem to produce classes of the greatest genetic similarity. The suborders are more narrowly defined than the orders. The soil properties used to separate suborders reflect the presence or absence of a high water table, climate, the accumulation of clay, iron, or organic carbon in the upper layer, cracking of soil caused by soil drying, and fine stratification. The names of suborders have two syllables. The second syllable indicates the order. An example is Aquoll (*aqu*, meaning water or wet, and *oll*, from Mollisol).

GREAT GROUPS. Soil suborders are divided into great groups on the basis of the kinds and sequence of soil horizons and features. The horizons used to make separations are those in which clay, carbonates, and other constituents have accumulated or from which they have been removed, and those that have pans that interfere with growth of roots, movement of water, or both. Some features used are soil acidity, climate, soil composition, and color. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is Haplaquoll (*Hapl*, meaning simple horizons, *aqu* for wetness or water, and *oll*, from Mollisols).

SUBGROUPS. Great groups are divided into subgroups, one representing the central (typic) segment of the group, and others called intergrades that have properties of the group and also one or more properties of another great group, suborder, or order. Other subgroups include soils that have properties unlike those of soils in any other great group, suborder, or order. The names of subgroups are made by placing one or more adjectives before the name of the great group. An example is Typic Haplaquolls (a typical Haplaquoll).

FAMILIES. Subgroups are divided into families mainly on the basis of properties important to the

[4] See the unpublished working document "Selected Chapters from the Unedited Text of the Soil Taxonomy" available in the SCS State Office, Columbia, Missouri.

TABLE 8.—*Classification of the soils*

Series	Family	Subgroup	Order
Arbela	Fine, montmorillonitic, mesic	Argiaquic Argialbolls	Mollisols.
Armstrong	Fine, montmorillonitic, mesic	Aquollic Hapludalfs	Alfisols.
Auxvasse	Fine, montmorillonitic, mesic	Aeric Albaqualfs	Alfisols.
Blackoar	Fine-silty, mixed, mesic	Fluvaquentic Haplaquolls	Mollisols.
Calwoods	Fine, montmorillonitic, mesic	Aeric Ochraqualfs	Alfisols.
Chariton	Fine, montmorillonitic, mesic	Mollic Albaqualfs	Alfisols.
Chequest	Fine, montmorillonitic, mesic	Typic Haplaquolls	Mollisols.
Fatima	Fine-silty, mixed, mesic	Fluvaquentic Hapludolls	Mollisols.
Gara	Fine-loamy, mixed, mesic	Mollic Hapludalfs	Alfisols.
Gifford	Fine, montmorillonitic, mesic	Vertic Ochraqualfs	Alfisols.
Gorin	Fine, montmorillonitic, mesic	Aquic Hapludalfs	Alfisols.
Gosport [1]	Fine, illitic, mesic	Typic Dystrochrepts	Inceptisols.
Goss	Clayey-skeletal, mixed, mesic	Typic Paleudalfs	Alfisols.
Keswick	Fine, montmorillonitic, mesic	Aquic Hapludalfs	Alfisols.
Kickapoo	Coarse-loamy, mixed, nonacid, mesic	Typic Udifluvents	Entisols.
Kilwinning	Fine, montmorillonitic, mesic	Vertic Ochraqualfs	Alfisols.
Leonard	Fine, montmorillonitic, mesic	Vertic Ochraqualfs	Alfisols.
Lindley	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Marion	Fine, montmorillonitic, mesic	Albaquic Hapludalfs	Alfisols.
Mexico	Fine, montmorillonitic, mesic	Udollic Ochraqualfs	Alfisols.
Moniteau	Fine-silty, mixed, mesic	Typic Ochraqualfs	Alfisols.
Piopolis	Fine-silty, mixed, acid, mesic	Typic Fluvaquents	Entisols.
Putnam	Fine, montmorillonitic, mesic	Mollic Albaqualfs	Alfisols.
Vigar [2]	Fine-loamy, mixed, mesic	Aquic Argiudolls	Mollisols.
Wabash	Fine, montmorillonitic, mesic	Vertic Haplaquolls	Mollisols.

[1] In this survey area, Gosport soils are taxadjuncts to the Gosport series. They have thicker layers, a more strongly developed B horizon, and redder mottles than is defined in the range for the series.
[2] In this survey area, Vigar soils are taxadjuncts to the Vigar series. They have color values greater than 4 and mottles in the horizon underlying the mollic epipedon.

growth of plants or to the behavior of soils when used for engineering purposes. These properties include texture, mineral composition, reaction, temperature, permeability, depth, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineral composition, and the other properties used to differentiate families (see table 8). An example is the fine, montmorillonitic, mesic family of Typic Haplaquolls.

Additional Facts About the Counties

In this section early settlement in the survey area and the present population are discussed briefly; data on climate are reviewed; farming, business, transportation, and education are discussed; and trends in land use are described.

History and Development

The territory in which Knox, Monroe, and Shelby Counties are located was originally partly prairie where the areas are level to slightly rolling and wooded where the areas are more rolling and steeper. Pioneers began settling in the territory in the early 1800's.

Monroe County was originally part of Ralls County, and Knox County was part of Scotland County. By Acts of the Missouri General Assembly, Monroe became a county in 1831 and Knox became a county in 1845 (*2*).

Early settlers came from Kentucky, Tennessee, Ohio, Indiana, Maryland, and other parts of Missouri. They raised most of their own food and made most of their own clothes. Food staples and equipment needs were purchased from trading posts on the Mississippi and Missouri Rivers.

Immigration continued, and population growth was rapid just before and soon after the Civil War. For example, early records show that in Shelby County the population grew from about 3,056 in 1840 to 14,024 by 1880 (*7*). Population reached a peak late in the 1890's and early in the 1900's and has declined since 1920. U.S. Census figures show that the population of Knox County declined from 10,783 in 1920 to 5,692 in 1970. During the same period, the population of Monroe County declined from 16,414 to 9,542, and that of Shelby County declined from 13,617 to 7,906 (*8*).

Farming, Business, Transportation, and Education

Although farming is the main occupation, the area contains more than 30 small manufacturing and mining industries that employ over a thousand people (*5*). Numerous other businesses such as banks, elevators, and implement, fertilizer, and chemical concerns depend upon farming.

Two Federal highways cross Monroe and Shelby Counties. Along with several state highways and county roads, they provide a system for automobile and truck transportation. Two railroads supply the southern part of the area with freight service.

Most of the small communities have elementary schools, and six of the larger communities have high schools.

Trends in Land Use

Cannon Dam and Reservoir are presently under construction. The dam will be about 4 miles east of the Monroe County line in Ralls County on the Salt River. It will provide flood protection, recreation, and hydroelectric power. The use of hundreds of acres of soils will change in the next two decades. It is estimated that the 18,000-acre reservoir and surrounding area will attract nearly four million visitors each year. With the completion of this reservoir will come the need for facilities, services, and businesses to accommodate the visitors.

Climate [5]

In preparing the information in this section, records at Steffenville, Missouri, were consulted to determine the climate of Knox, Monroe, and Shelby Counties. Steffenville is about 5 miles east of the Knox County line. The records are for the years 1937 through 1966.

Knox, Monroe, and Shelby Counties have a typical continental-type climate. The highest temperature on record at Steffenville is 111° F, recorded in 1954, and the coldest temperature is −17°, recorded in 1950. Since 1937 the greatest annual precipitation was 49.96 inches in 1969 and the smallest annual precipitation was 23.22 inches in 1963.

[5] Prepared by WAYNE L. DECKER, chairman, Atmospheric Science, College of Agriculture, University of Missouri, Columbia.

Winter in these three counties of northeast Missouri tends to have comparatively light precipitation. During November through February about 20 percent of the annual average precipitation is reported. Snow fell in each of the 30 years from 1937 through 1966. About 1 year in 10 has less than 10 inches of snow, and about 1 in 4 has more than 30 inches.

As the air warms early in spring, the amount of precipitation increases. Rain is usually abundant throughout May and June. Beginning in July there is a gradual decline in average precipitation that continues into the winter. The demand for water by growing plants is greatest during July and August.

The survey area is subject to wide variations in temperature from season to season. The largest day-to-day variations are in fall and winter. In summer the change in temperature from week to week is likely to be more gradual and smaller in magnitude.

January is usually the coldest month, but it commonly has several days when the temperatures rises above 50°. Summer is hot, but rarely does the temperature rise above 100° for 4 or 5 consecutive days.

Tables 9 and 10 provide climatic data that are representative of the survey area. The column "Average heating degree days" in table 9 provides a comparative number, or average, for calculating relative heating requirements for dwellings. Fuel consumption for heating is proportional to total degree days; that is, a month that has twice as many degree days as another month requires twice as much fuel for heating.

TABLE 9.—*Temperature*

[Data from Steffenville, Lewis County, Mo.

Month	Temperature [1]							Average heating degree-days [1,2]	Precipitation [1] Rainfall	
	Average daily maximum	Average daily minimum	Average	Record high	Year	Record low	Year		Average	Maximum in 24-hour period
	°F	*°F*	*°F*	*°F*		*°F*			*Inches*	*Inches*
January	36.1	16.9	26.5	73	1950	−17	1965	1,193	1.76	2.65
February	41.3	21.8	31.5	73	1954	−15	1944	946	1.41	1.69
March	51.0	29.6	40.3	84	1938	−11	1960	768	2.90	2.68
April	64.8	41.7	53.3	91	1956	16	1957	367	3.51	3.08
May	75.3	52.3	63.8	97	1944	29	1966	124	3.88	2.83
June	83.4	61.5	72.4	100	1937	41	1966	14	4.44	2.50
July	88.5	65.0	76.8	111	1954	45	1947	0	4.10	4.31
August	87.3	63.6	75.4	105	1940	42	1950	4	3.71	3.97
September	80.1	55.0	67.5	104	1947	24	1942	72	3.15	5.13
October	70.3	45.1	57.7	98	1939	18	1942	260	2.89	4.42
November	53.3	32.2	42.7	87	1958	−10	1964	670	2.00	2.75
December	40.5	22.0	31.2	71	1949	−16	1948	1,047	1.55	1.72
Year	64.4	42.3	53.4	111	1954	−17	1965	5,466	35.29	5.13

[1] Average length of record, 30 years.

Literature Cited

(1) American Association of State Highway [and Transportation] Officials. 1961. Standard specifications for highway materials and methods of sampling and testing. Ed. 8, 2 vol., illus.

(2) Goodspeed Publishing Co., St. Louis and Chicago. 1887. History of Lewis, Clark, Knox, and Scotland Counties, Missouri. Repr. by Stevens Publ. Co. in coop. with Northeast Mo. Libr. Serv. pp. 555–746. Illus.

(3) Lemmon, Paul E. 1958. Soil interpretations for woodland conservation. *In* Proc. of the First No. Amer. Forest Soils Conf., Mich. Agric. Exp. Stn., pp. 153–158.

(4) __________. 1968. Grouping soils on the basis of woodland suitability. *In* Tree Growth and Forest Soils. Proc. of the Third No. Amer. Forest Soils Conf. held at N.C. State Univ. at Raleigh, pp. 413–426.

(5) Missouri Division of Commerce and Industrial Development. 1971. Missouri directory of manufacturing and mining. 521 pp., illus.

(6) Portland Cement Association. 1956. PCA soil primer. 86 pp., illus.

(7) St. Louis National Historical Co. and Historical Societies of Monroe and Shelby Counties. 1969. History of Monroe and Shelby counties, Missouri. pp 87–1,176, illus.

(8) United States Bureau of Census, 1970. United States census of population, general population, Missouri. 545 pp., illus.

(9) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplement issued May 1962]

(10) __________. 1960. Soil classification, a comprehensive system, 7th approximation. 265 pp., illus. [Supplement issued March 1967]

(11) __________. 1961. Land-capability classification. U.S. Dep. Agric. Handb. 210, 21 pp.

(12) __________. 1971. Guide for interpreting engineering uses of soils. 87 pp.

Glossary

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Base saturation. The degree to which material that has base-exchange properties is saturated with exchangeable cations other than hydrogen, expressed as a percentage of the cation-exchange capacity.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Claypan. A compact, slowly permeable soil horizon that contains much more clay than the horizon above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure

and precipitation data

Period of record 1937–66]

Precipitation [1]—Continued: Rainfall—Contd.						Average number of days with—[1]				
	Snow and sleet						Temperature			
							Maximum		Minimum	
Year	Average	Maximum monthly	Year	Maximum in 24-hour period	Year	Precipitation of 0.10 inch or more	90° and above	32° and below	Between 0° and 32°	0° and below
	Inches	*Inches*		*Inches*						
1965	6.6	13.5	1939	8.0	1959	4	0	12	28	4
1955	4.9	13.2	1964	7.5	1944	4	0	6	24	1
1944	5.1	18.0	1965	7.0	1960	6	0	2	20	0
1956	.6	7.0	1953	7.0	1953	7	0	0	5	0
1955	0	0	----------	0	----------	7	1	0	0	0
1953	0	0	----------	0	----------	7	6	0	0	0
1958	0	0	----------	0	----------	6	13	0	0	0
1938	0	0	----------	0	----------	5	12	0	0	0
1947	0	0	----------	0	----------	5	5	0	0	0
1955	0	0	----------	0	----------	5	0	0	4	0
1938	1.6	7.5	1964	6.5	1964	4	0	2	16	0
1946	5.8	14.1	1943	7.5	1943	4	0	8	26	2
1947	24.5	18.0	1965	8.0	1959	64	37	30	123	7

[2] Based on a temperature of 65° and computed from average monthly temperatures.

TABLE 10.—*Probabilities of last freezing temperatures in spring and first in fall*

[Data from Steffenville, Lewis County, Mo.]

Probability	Dates for given probability and temperature				
	16° or lower	20° or lower	24° or lower	28° or lower	32°or lower
Spring:					
1 year in 10 later than	March 30	April 8	April 17	April 23	May 4
2 years in 10 later than	March 23	April 1	April 11	April 17	April 29
5 years in 10 later than	March 11	March 21	March 30	April 8	April 20
Fall:					
1 year in 10 earlier than	November 11	October 28	October 17	October 12	September 29
2 years in 10 earlier than	November 17	November 3	October 23	October 18	October 4
5 years in 10 earlier than	November 26	November 13	November 4	October 28	October 14

between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sequioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Loess. Fine-grained material, dominantly of silt-sized particles.

Mottled. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are these: *fine*, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium*, ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse*, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Natural soil drainage. Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and in some soils mottles commonly are below 6 to 16 inches, in the lower A horizon and in the B and C horizons.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the redder parts of the profile.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid,* and *very rapid.*

pH value. A numerical means for designating acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Residuum. Unconsolidated, partly weathered mineral material that accumulates over disintegrating solid rock. Residual material is not soil but is frequently the material in which a soil has formed.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Upland (geology). Land consisting of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowlands along rivers.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Weathering. All physical and chemical changes produced in rocks at or near the earth's surface by atmospheric agents. These changes result in more or less complete disintegration and decomposition of the rock.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and the description of the soil series to which the mapping unit belongs. In referring to a capability unit, read the introduction to the section. It provides general information about management of the soils for crops and pasture.

Map symbol	Mapping unit	Described on page	Capability unit Symbol	Capability unit Page
Ar	Arbela silt loam	6	IIw-1	22
AtC	Armstrong loam, 5 to 9 percent slopes	7	IIIe-5	22
AtD2	Armstrong loam, 9 to 14 percent slopes, eroded	7	IVe-5	23
Au	Auxvasse silt loam	8	IIIw-2	22
Bk	Blackoar silt loam	8	IIw-1	22
CaB	Calwoods silt loam, 2 to 5 percent slopes	9	IIe-5	22
Ch	Chariton silt loam	9	IIw-2	22
Cm	Chequest silty clay loam	10	IIw-2	22
Fa	Fatima silt loam	10	I-1	21
GaD	Gara loam, 9 to 14 percent slopes	11	IVe-1	23
GaE	Gara loam, 14 to 20 percent slopes	11	VIe-1	24
GfB	Gifford silt loam, 2 to 5 percent slopes	11	IIe-5	22
GfC	Gifford silt loam, 5 to 9 percent slopes	11	IIIe-5	22
GoC2	Gorin silt loam, 5 to 9 percent slopes, eroded	12	IIIe-5	22
GpC	Gosport silty clay loam, 5 to 9 percent slopes	13	IVe-7	23
GpD	Gosport silty clay loam, 9 to 14 percent slopes	13	VIe-7	24
GpE	Gosport silty clay loam, 14 to 20 percent slopes	13	VIIe-7	25
GsF	Goss cherty silt loam, 20 to 30 percent slopes	13	VIIs-9	25
KeC2	Keswick loam, 5 to 9 percent slopes, eroded	14	IIIe-5	22
KeD2	Keswick loam, 9 to 14 percent slopes, eroded	14	IVe-5	23
Kk	Kickapoo fine sandy loam	14	IIIs-1	23
KlB	Kilwinning silt loam, 2 to 5 percent slopes	15	IIe-5	22
LcC2	Leonard silt loam, 5 to 9 percent slopes, eroded	16	IIIe-5	22
LcD2	Leonard silt loam, 9 to 14 percent slopes, eroded	16	IVe-5	23
LdE	Lindley loam, 14 to 20 percent slopes	16	VIe-4	24
LdF	Lindley loam, 20 to 30 percent slopes	16	VIIe-4	24
MaA	Marion silt loam, 0 to 2 percent slopes	17	IIIw-2	22
MaB	Marion silt loam, 2 to 5 percent slopes	17	IIIe-5	22
MeB	Mexico silt loam, 2 to 5 percent slopes	17	IIe-5	22
MeB2	Mexico silt loam, 2 to 5 percent slopes, eroded	18	IIIe-5	22
Mo	Moniteau silt loam	18	IIIw-2	22
Po	Piopolis silty clay loam	18	IIw-1	22
Pu	Putnam silt loam	19	IIw-2	22
Rk	Rock land	19	VIIs-10	25
VgB	Vigar loam, 2 to 5 percent slopes	20	IIe-2	22
Wa	Wabash silty clay	20	IIIw-14	22

☆ U.S. GOVERNMENT PRINTING OFFICE: 1979-207-350/122

Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at 1-800-457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.